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US Army Corps of Engineers

SHIP NAVIGATION SIMULATOR STUDY SACRAMENTO RIVER DEEPWATER SHIP CHANNEL PROJECT, SACRAMENTO, CALIFORNIA

Report 1
PHASE I

Volume II
Appendixes B and C

by

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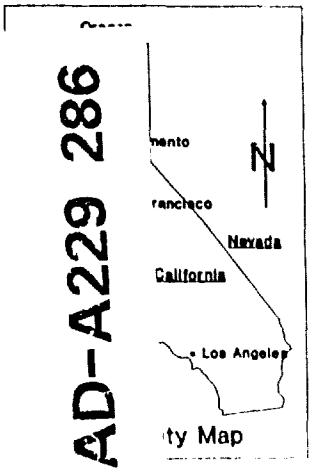
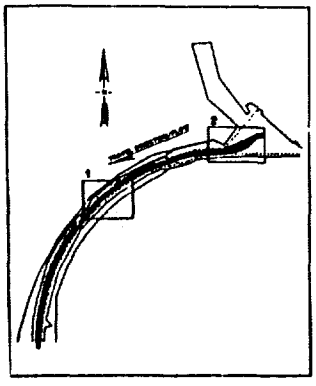
Hydraulics Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199

AD-A229 286





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September 1990
Report 1 of a Series

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Prepared for US Army Engineer District, Sacramento
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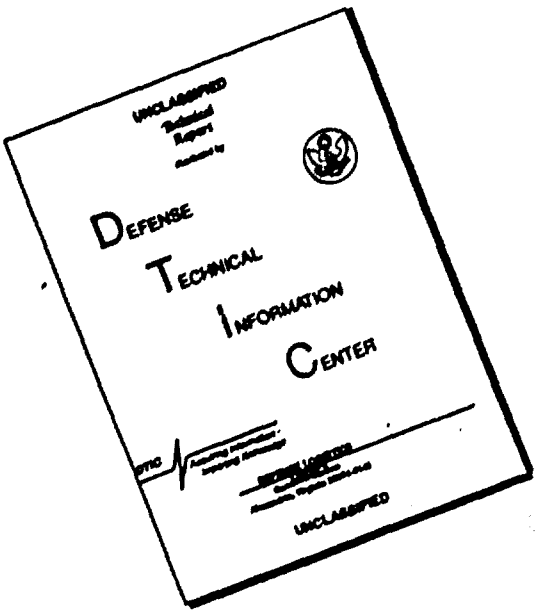

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17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Channel design; Sacramento Deepwater Ship Channel; Deepwater channel; Ship; Navigation; Simulation

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A real-time ship simulation investigation of the proposed design for deepening the man-made canal portion of the Sacramento Deepwater Ship Channel, Sacramento, CA, was conducted. The purpose of this study was to determine if the navigation channel could be deepened from 30 to 35 ft without widening from the existing channel width of 200 ft or if the channel would require widening to 250 ft as authorized. A numeric model of the existing ship channel from about channel mile 35 to the Sacramento Harbor was developed. This model was verified by a member of the San Francisco Bar Pilots Association. Numeric models of two plan conditions were also developed, one with the existing channel deepened to 35 ft and the other with the channel widened by 50 ft and deepened to 35 ft. In both plans the two bends were widened by 50 ft. Tests were run on the WES ship simulator in which six pilots from the San Francisco Bar Pilots Association conned the simulated ship through the three simulated channel conditions.

The tests showed that there was little difference between navigation of ships

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A

19. ABSTRACT (Continued).

in the existing channel and in the proposed channel which was deepened but not widened in the straight reaches. Slightly but consistently better control ~~is~~ was evident in the proposed channel. Larger bank clearances were evident with the 50-ft widening. ~~Also,~~ and control of the ship appeared to be easier. The wider channel would provide more allowance for error, drift, and wind effects on the ships; however, the existing channel is not considered a navigation problem.

Appendix B presents track plots of each pilot's runs and Appendix C presents bar charts of statistical parameters in comparison format in addition to those discussed in the main text.

It is recommended that when the Sacramento Deepwater Ship Channel from mile 18.6 to the Sacramento Harbor is deepened by 5 ft (from 30 to 35 ft), the straight sections can remain 200 ft wide and the turns should be widened to 250 ft.

Keywords: Water channel test facilities; Ship models; Hydraulic models; Test/evaluation; Banks/waterways; Channels/waterways; ~~(MM)~~

Deep water channels. (MM)

APPENDIX B

LOWER SACRAMENTO TRACK LINES

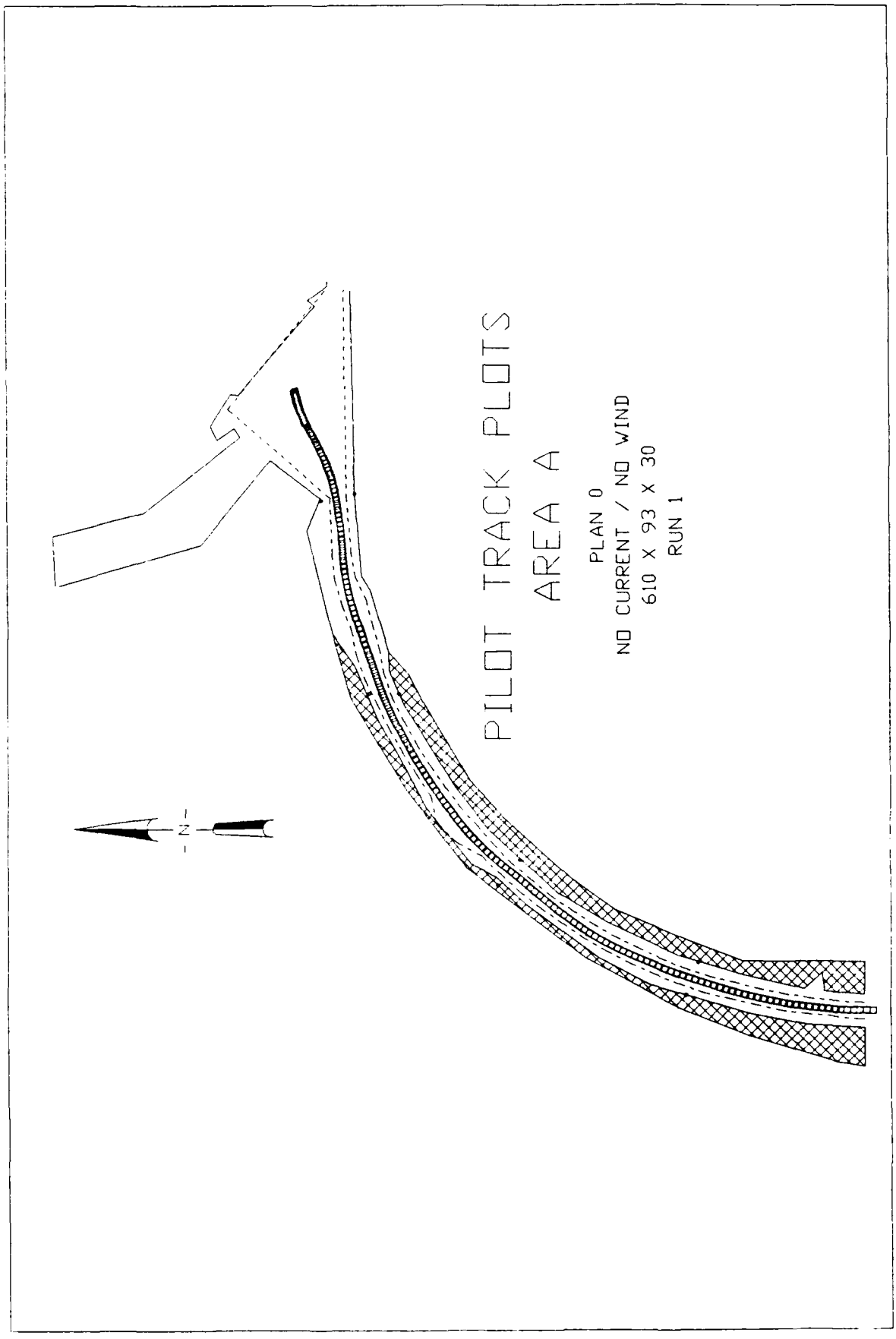
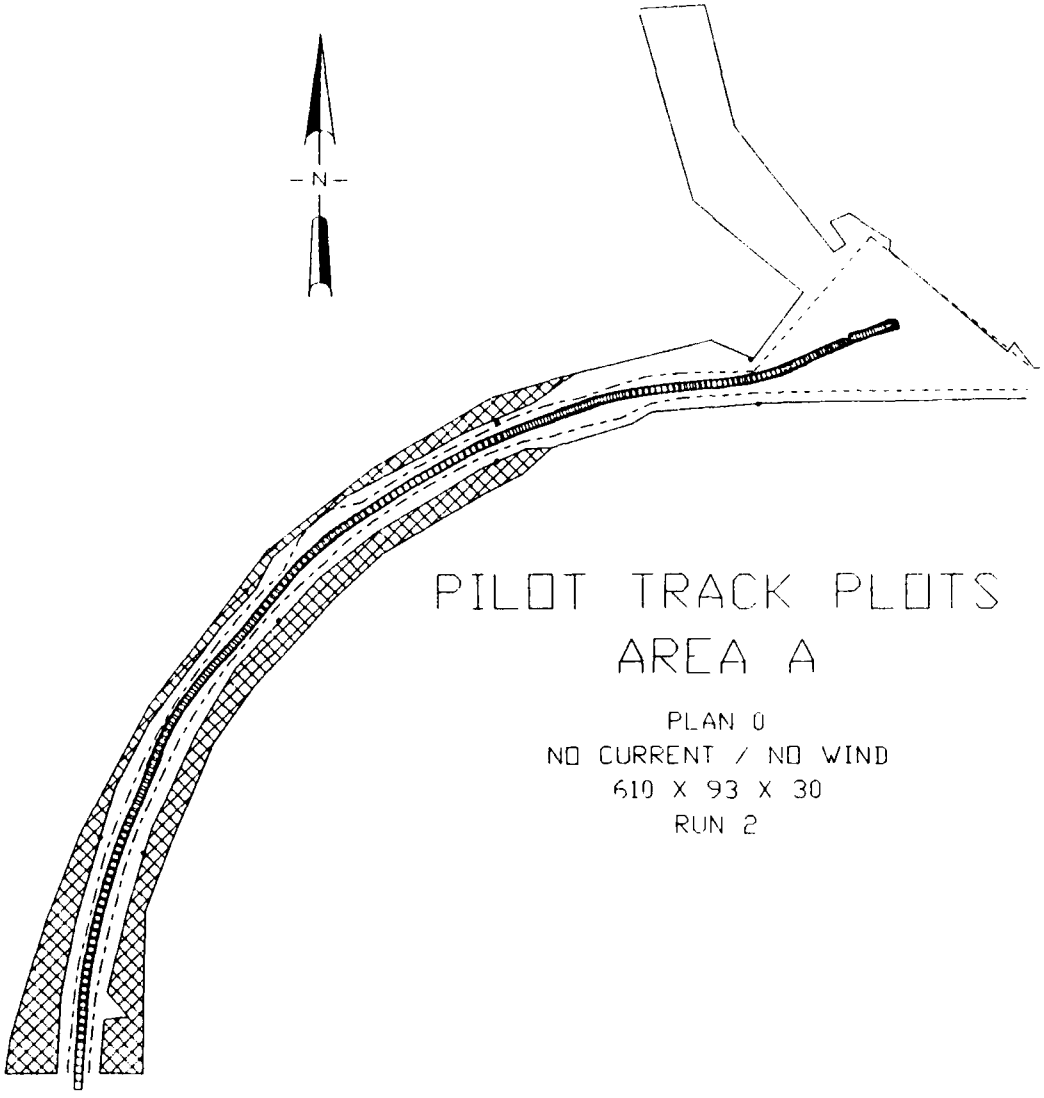

PILOT TRACK PLOTS
AREA A
PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 1
N

PLATE B1

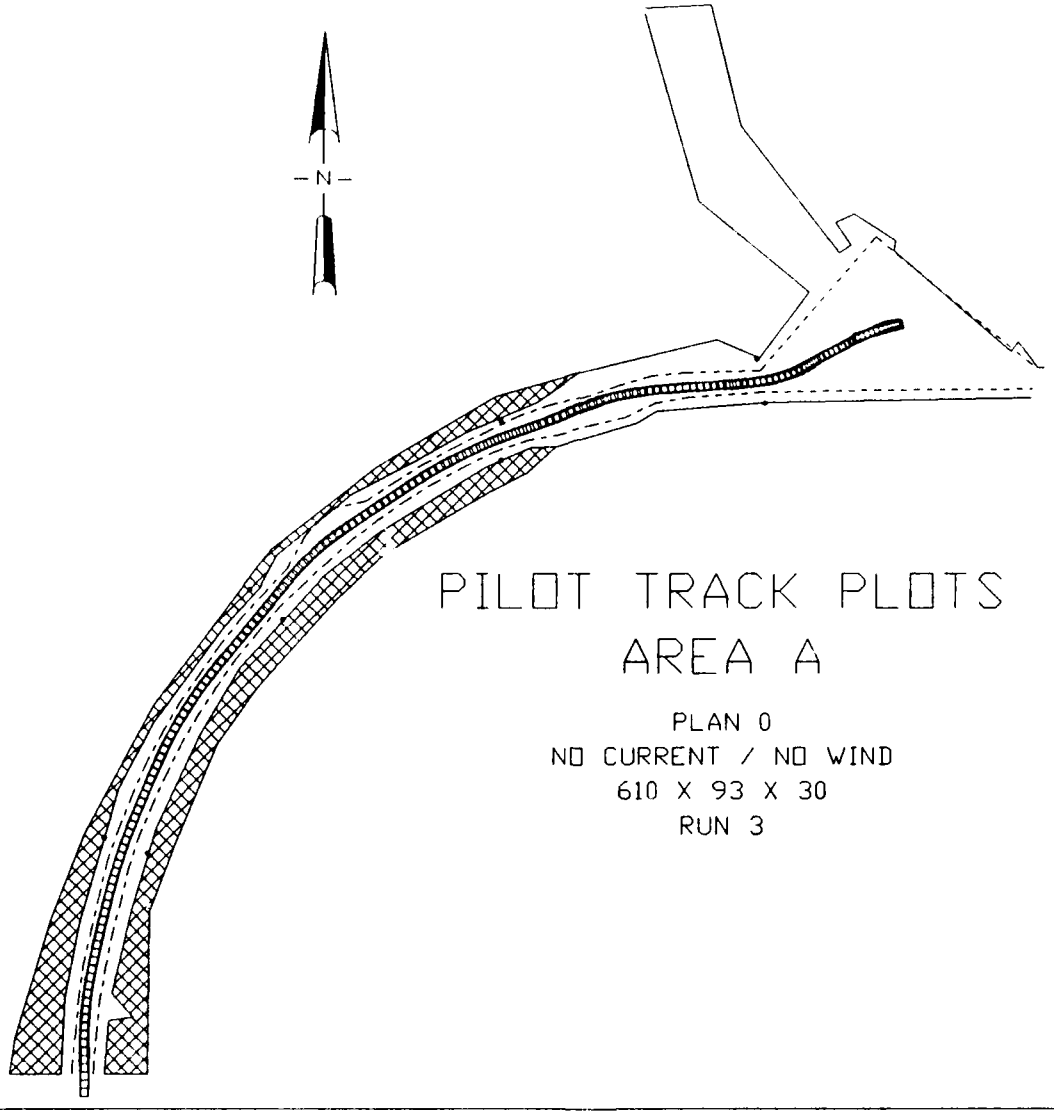
A-1

PLATE B2



PILOT TRACK PLOTS
AREA A

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 2

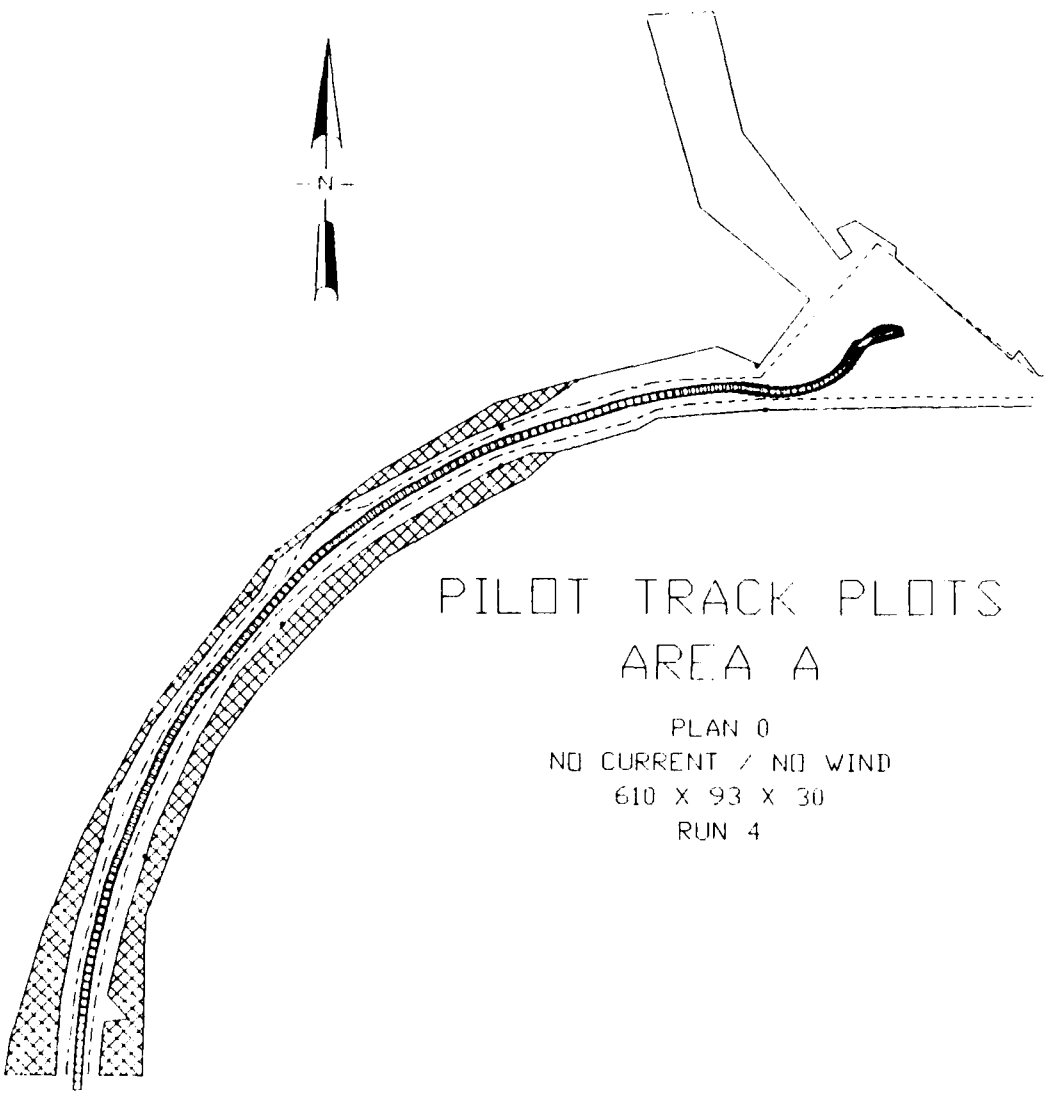


PILOT TRACK PLOTS
AREA A

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 3

PLATE B3

PLATE B4



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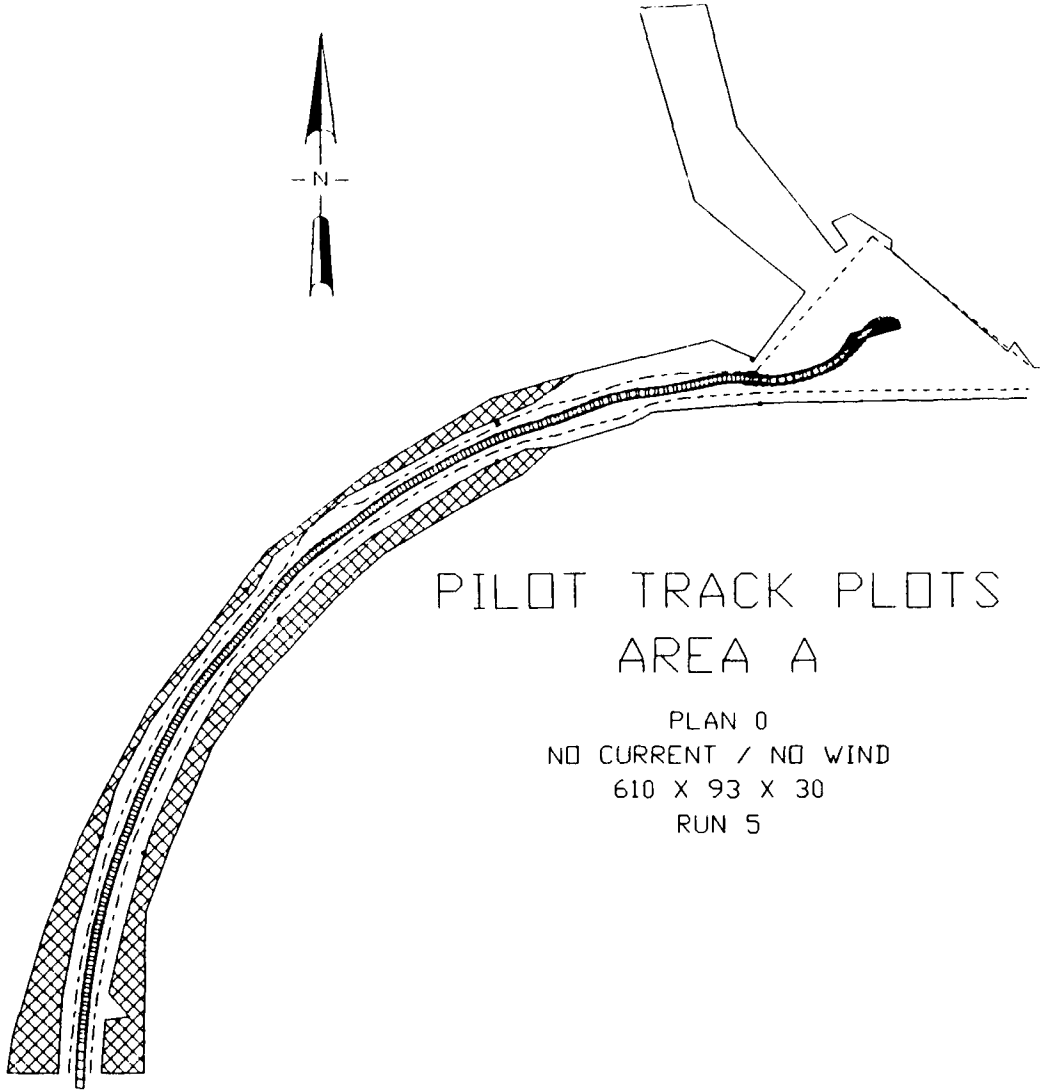
RUN 4

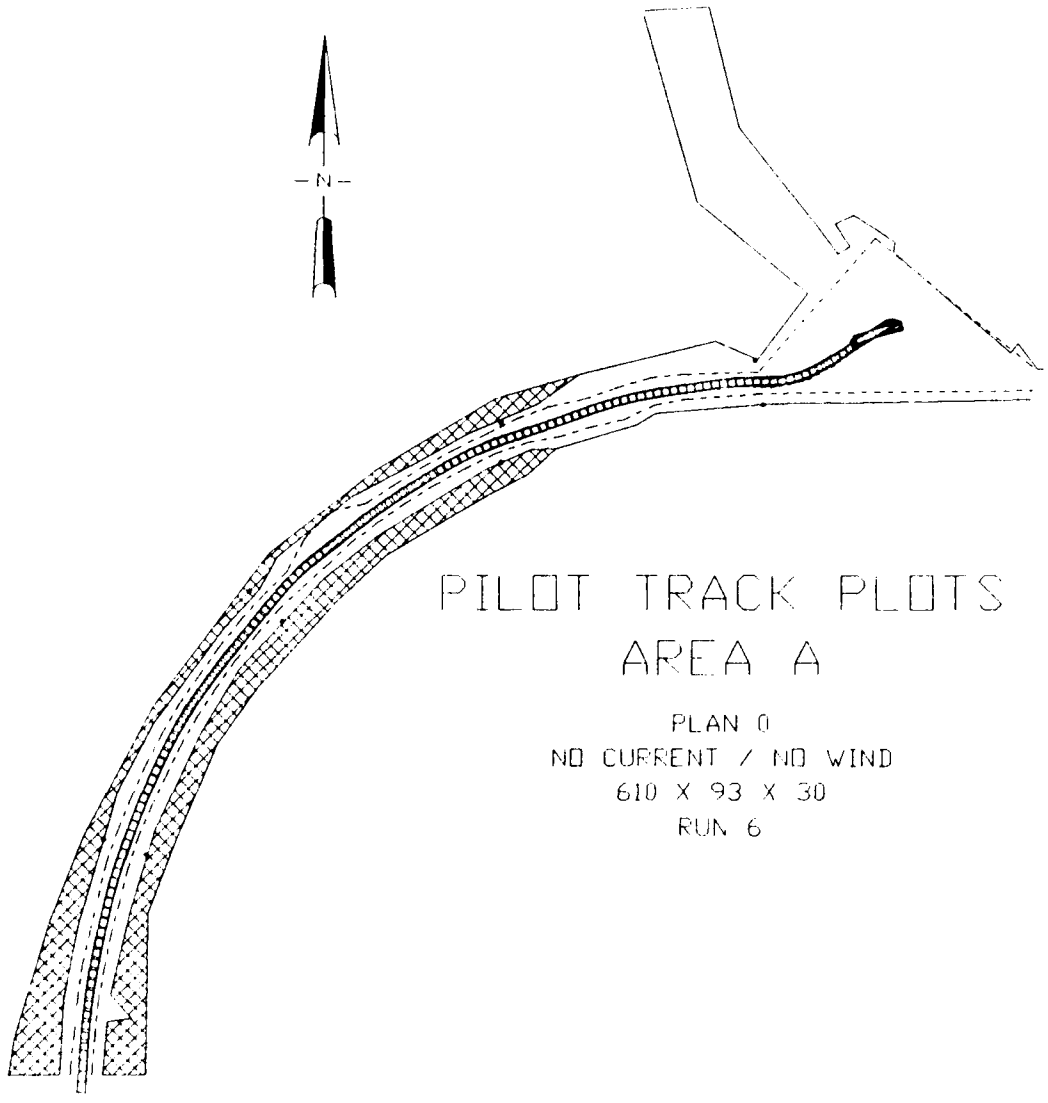


PILOT TRACK PLOTS
AREA A

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 5

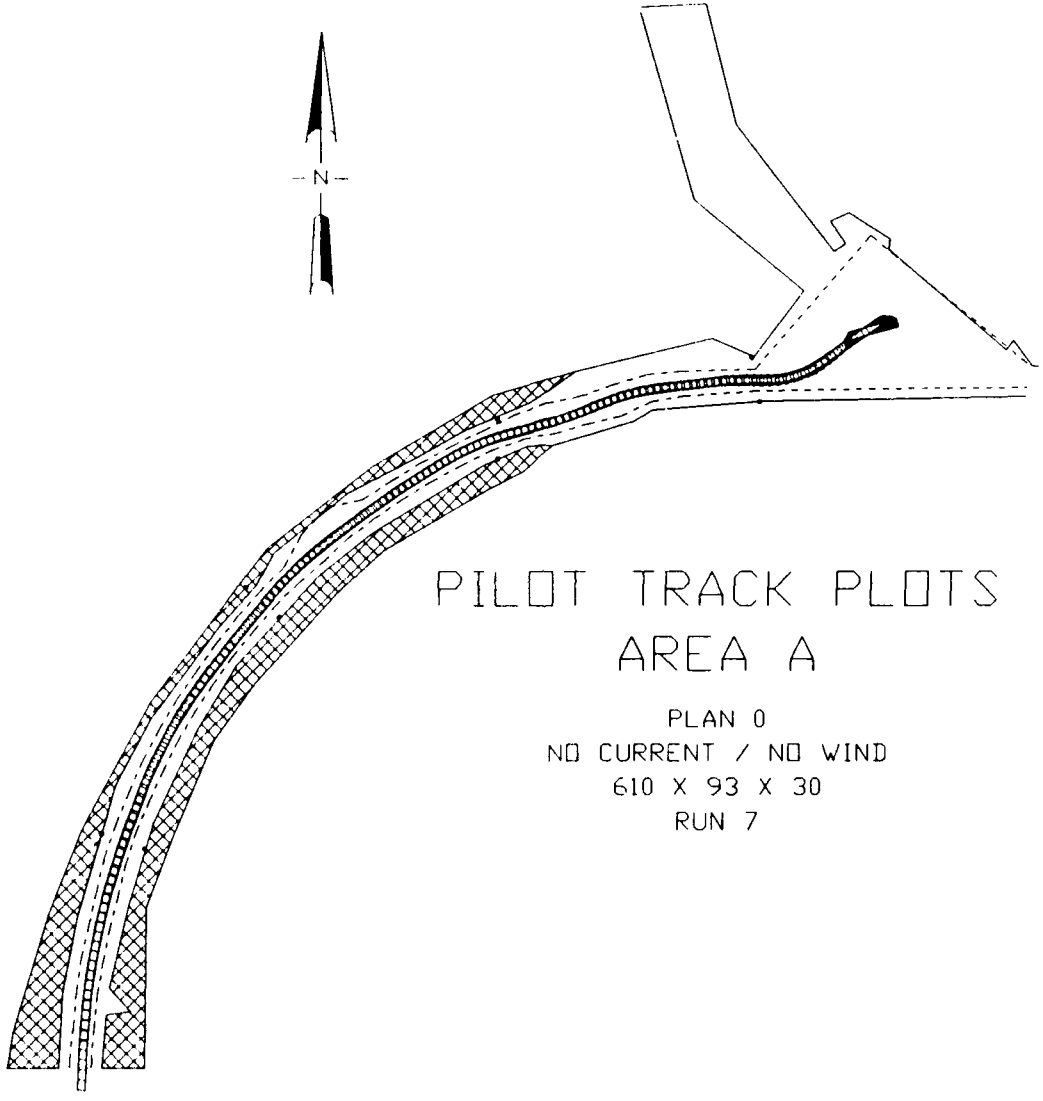
PLATE B5

PLATE B6



PILOT TRACK PLOTS
AREA A

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 6

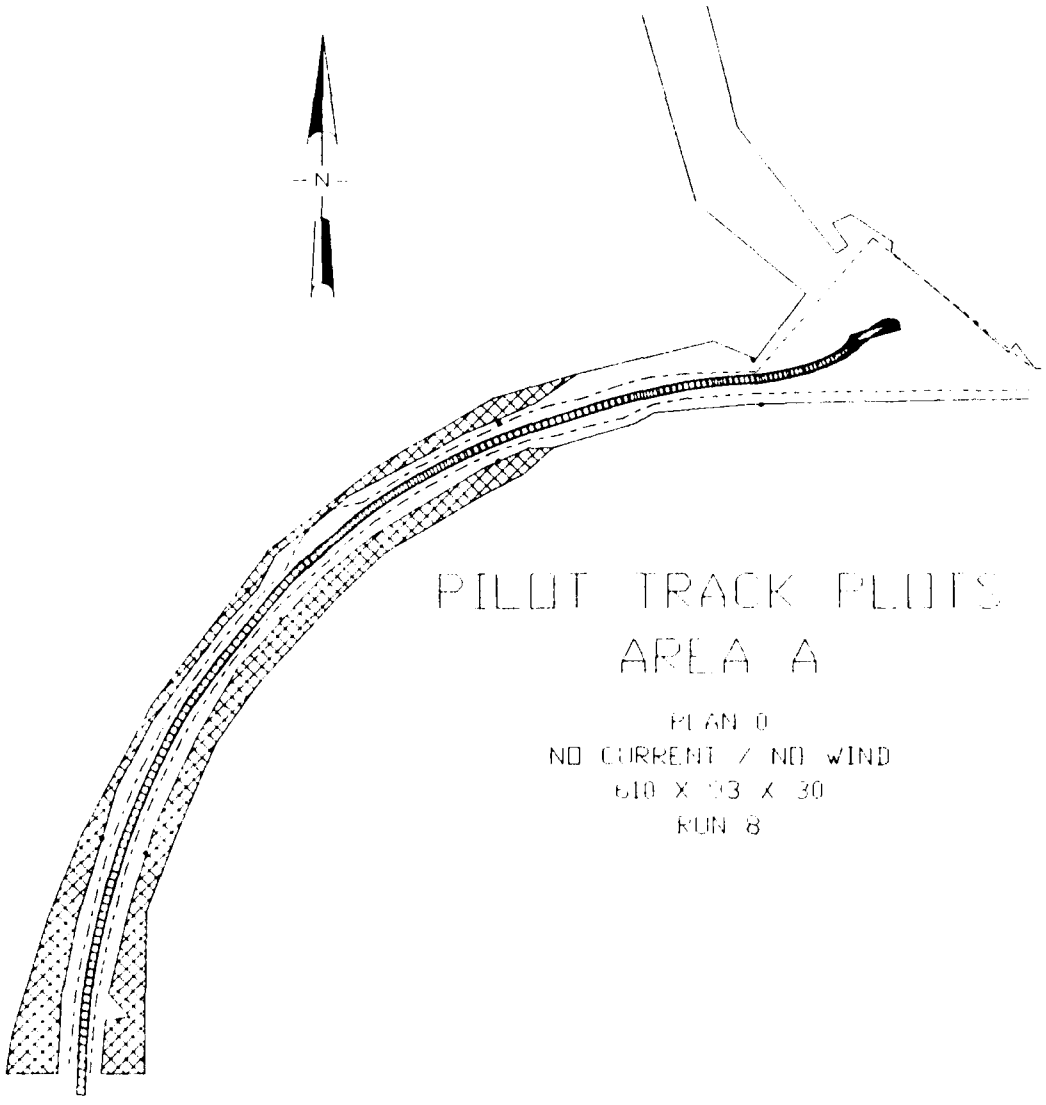


PILOT TRACK PLOTS
AREA A

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 7

PLATE B7

PLATE B8



PILOT TRACK PLOTS

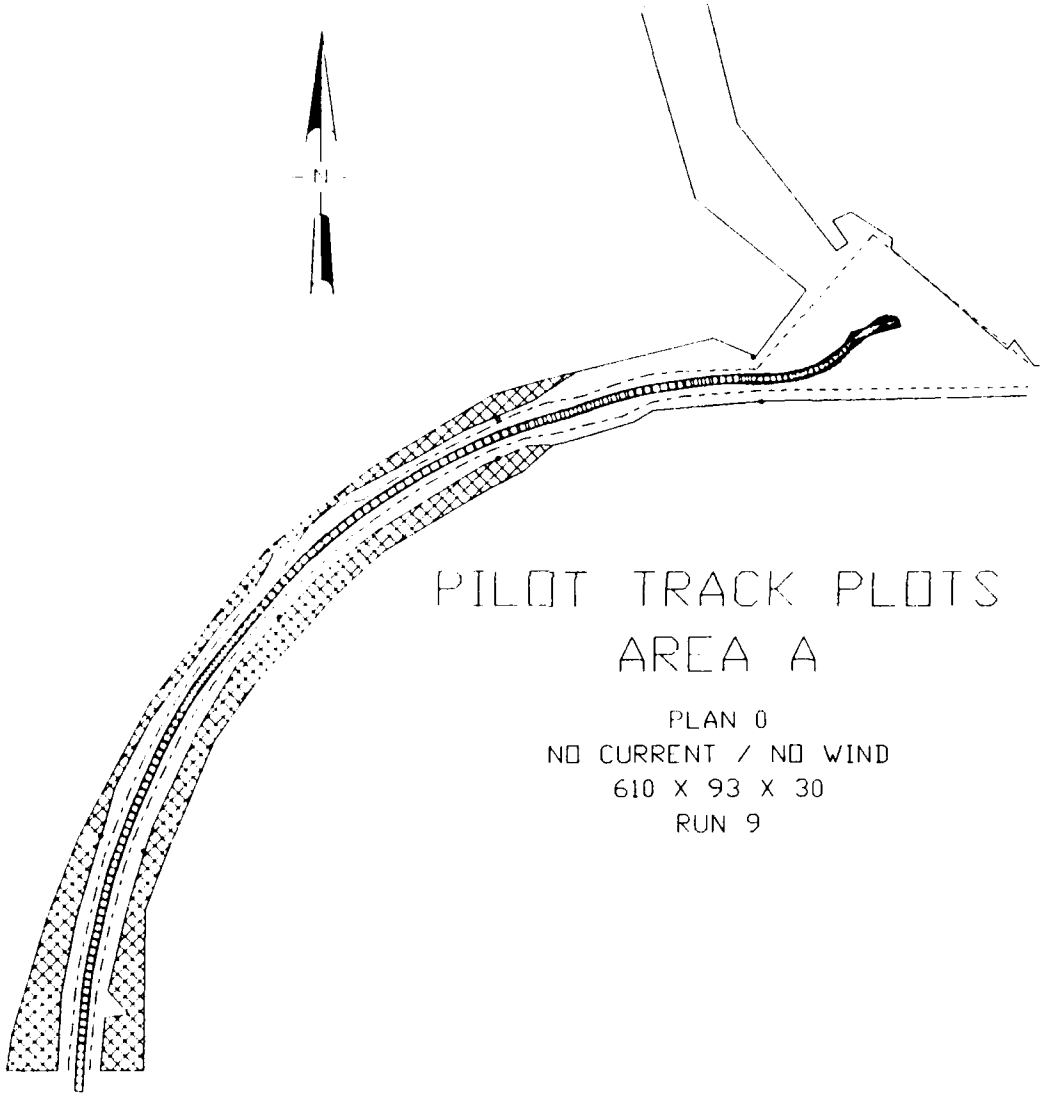
AREA A

PLAN 0

NO CURRENT / NO WIND

610 X 213 X 30

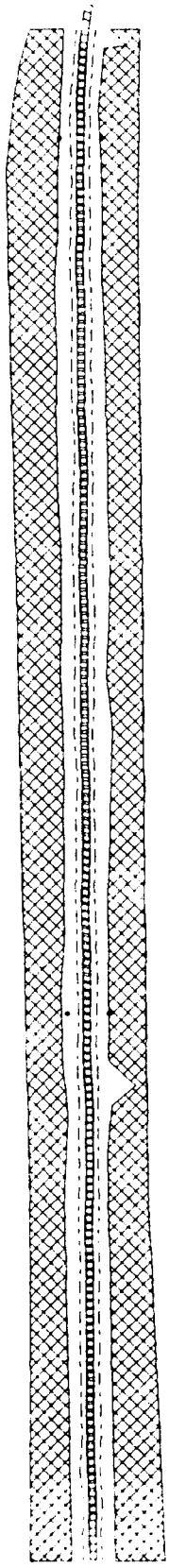
RUN 8

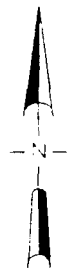


PILOT TRACK PLOTS
AREA A

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 9

PLATE B9

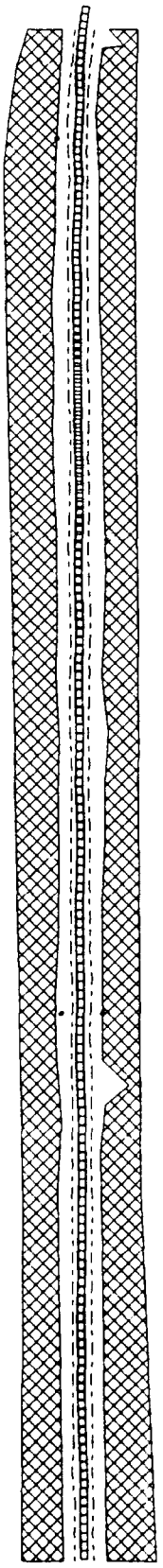


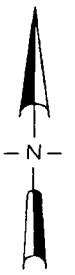


PILOT TRACK PLOTS
AREA B

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 1

PLATE B10

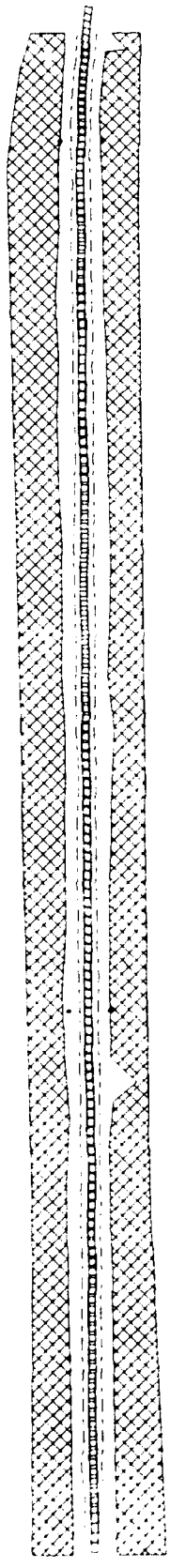




PILOT TRACK PLOTS
AREA B

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 2

PLATE B11

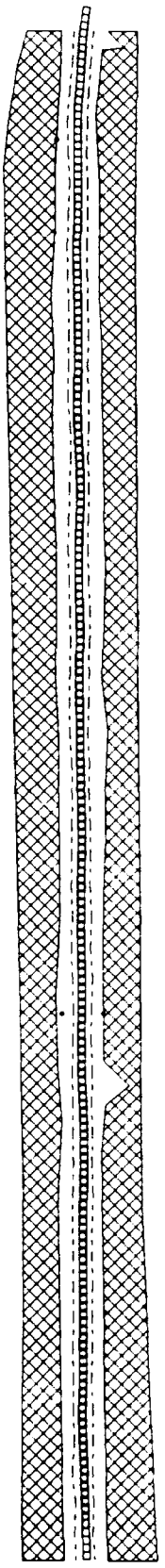


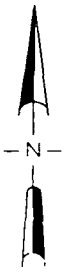
PILOT TRACK PLOTS

AREA B

PLAN 6
NO CURRENT / NO WIND
610 X 93 X 30
RUN 3

PLATE B12

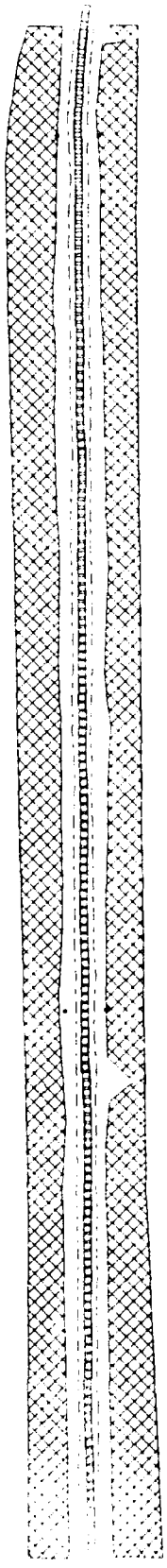




PILOT TRACK PLOTS
AREA B

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 4

PLATE B13

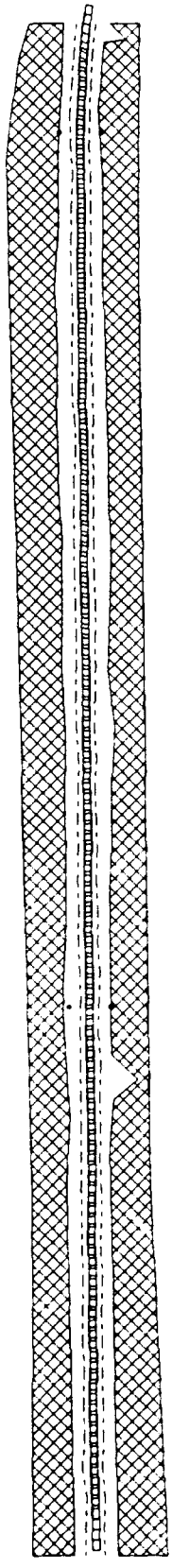


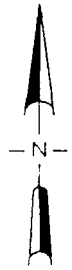
PILOT TRACK PLOTS

AREA B

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 5

PLATE B14

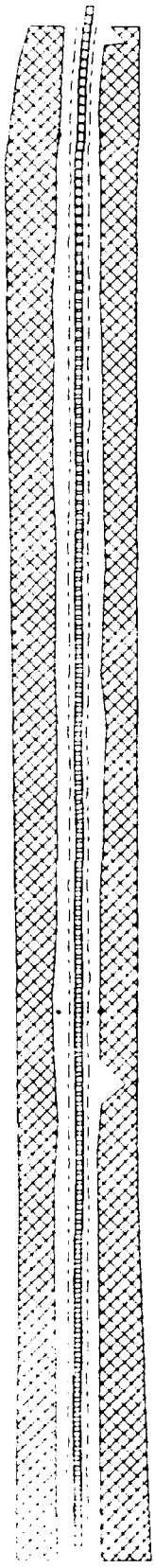


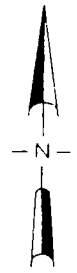


PILOT TRACK PLOTS
AREA B

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 6

PLATE B15



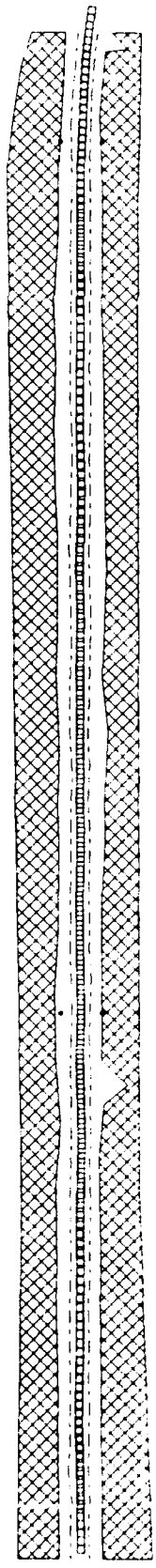


PILOT TRACK PLOTS

AREA B

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 7

PLATE B16

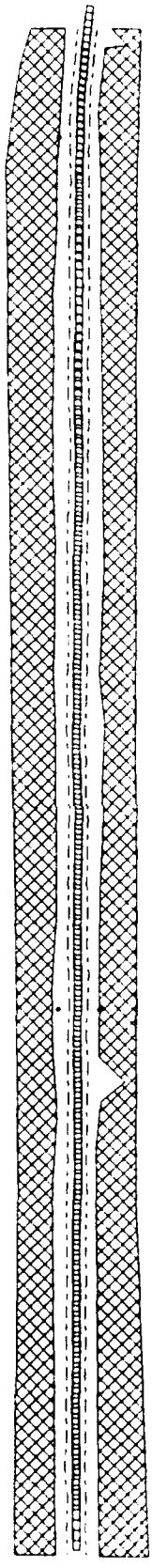


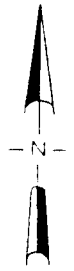
PILOT TRACK PLOTS

AREA B

PLAN 0
NO CURRENT / NO WIND
610 X 53 X 30
RUN 8

PLATE B17



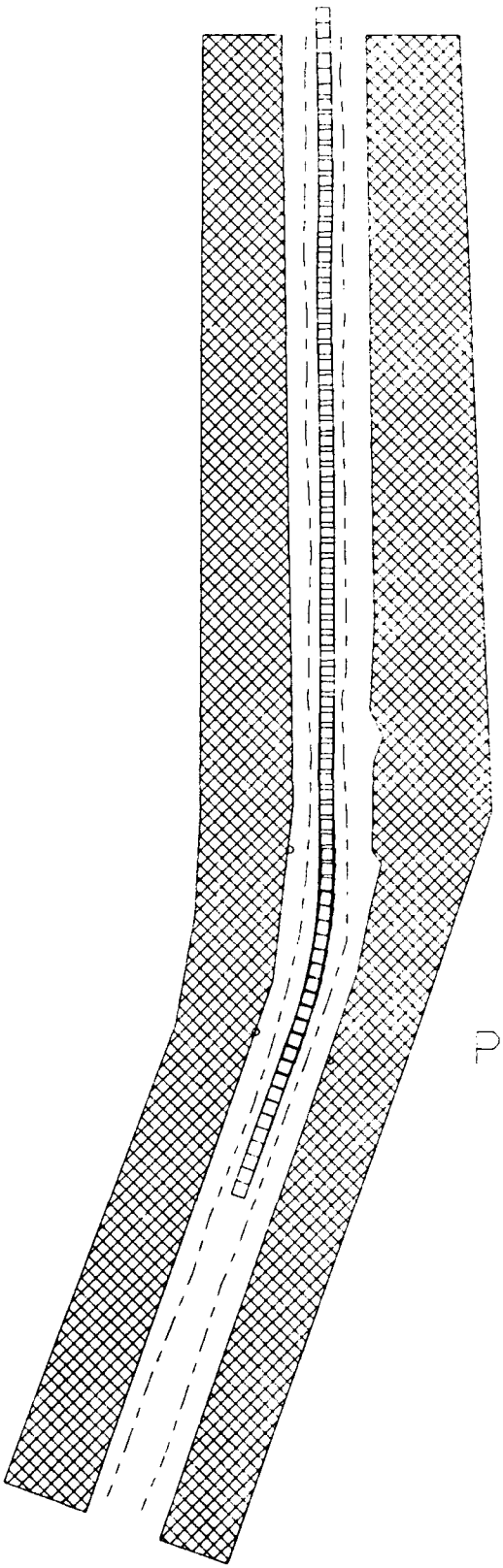


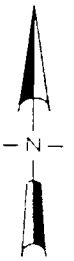
PILOT TRACK PLOTS

AREA B

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 9

PLATE B18

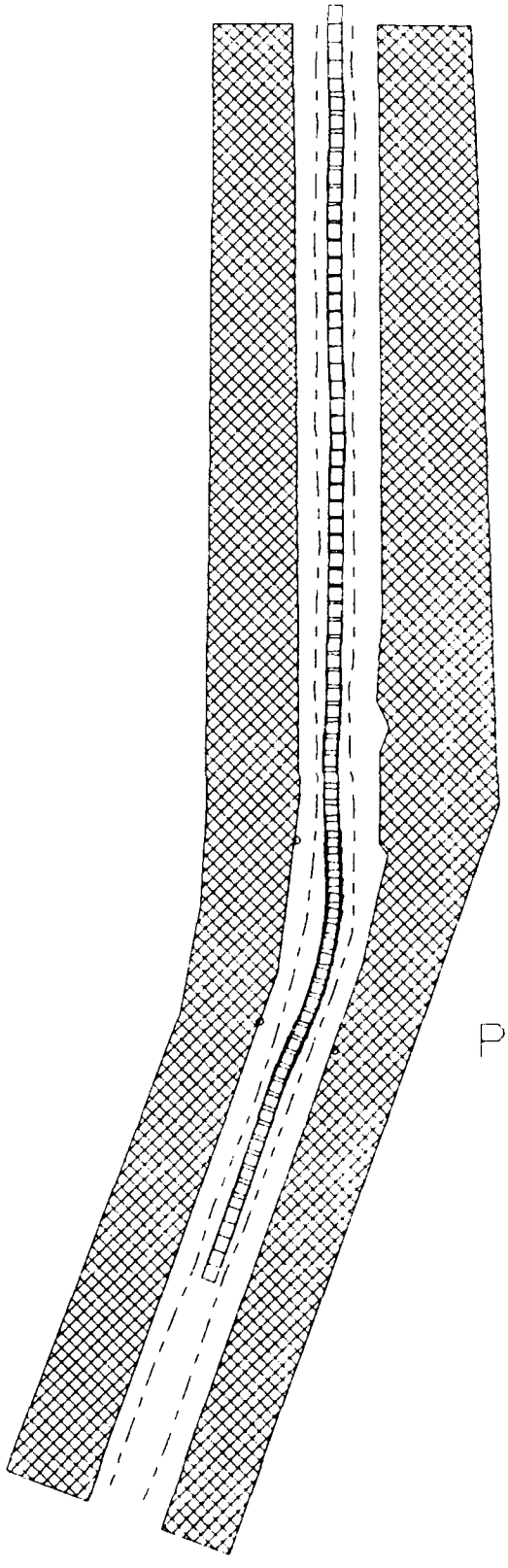


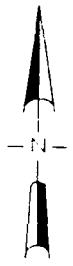


PILOT TRACK PLOTS
AREA C

PLAN C
NO CURRENT / NO WIND
610 X 93 X 30
RUN 1

PLATE B19





PILOT TRACK PLOTS
AREA C

PLAN 0
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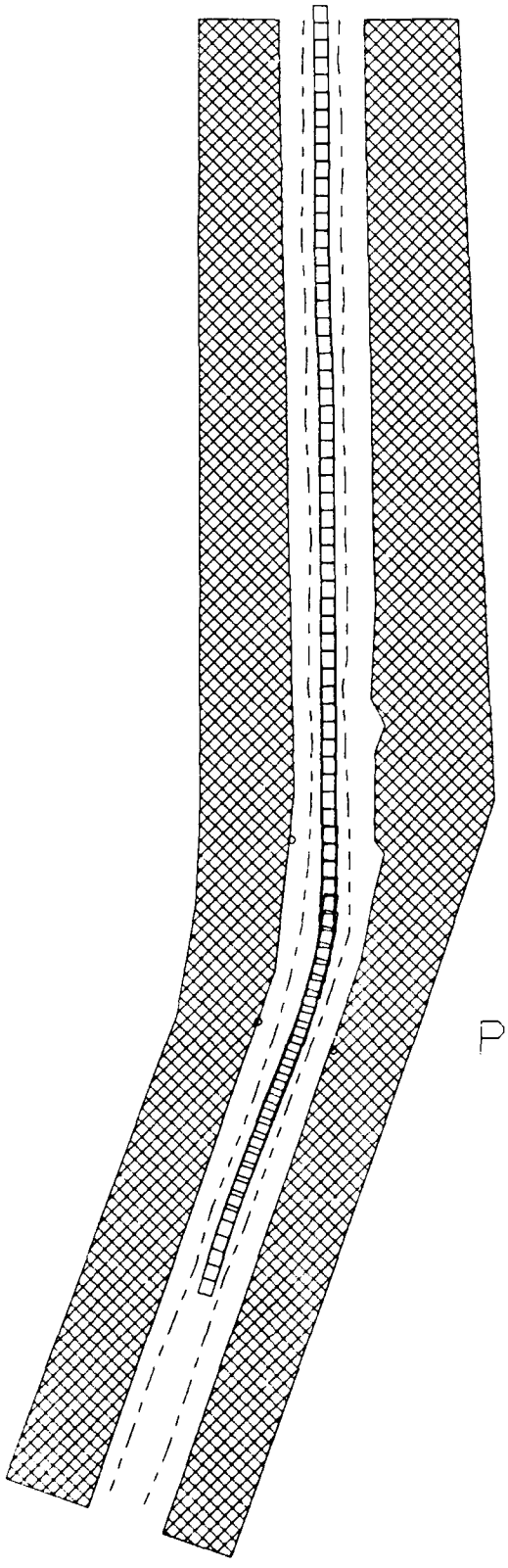
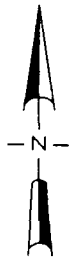
610 X 93 X 30
RUN 2

PLATE B20





PILOT TRACK PLOTS
AREA C

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610 X 93 X 30
RUN 3

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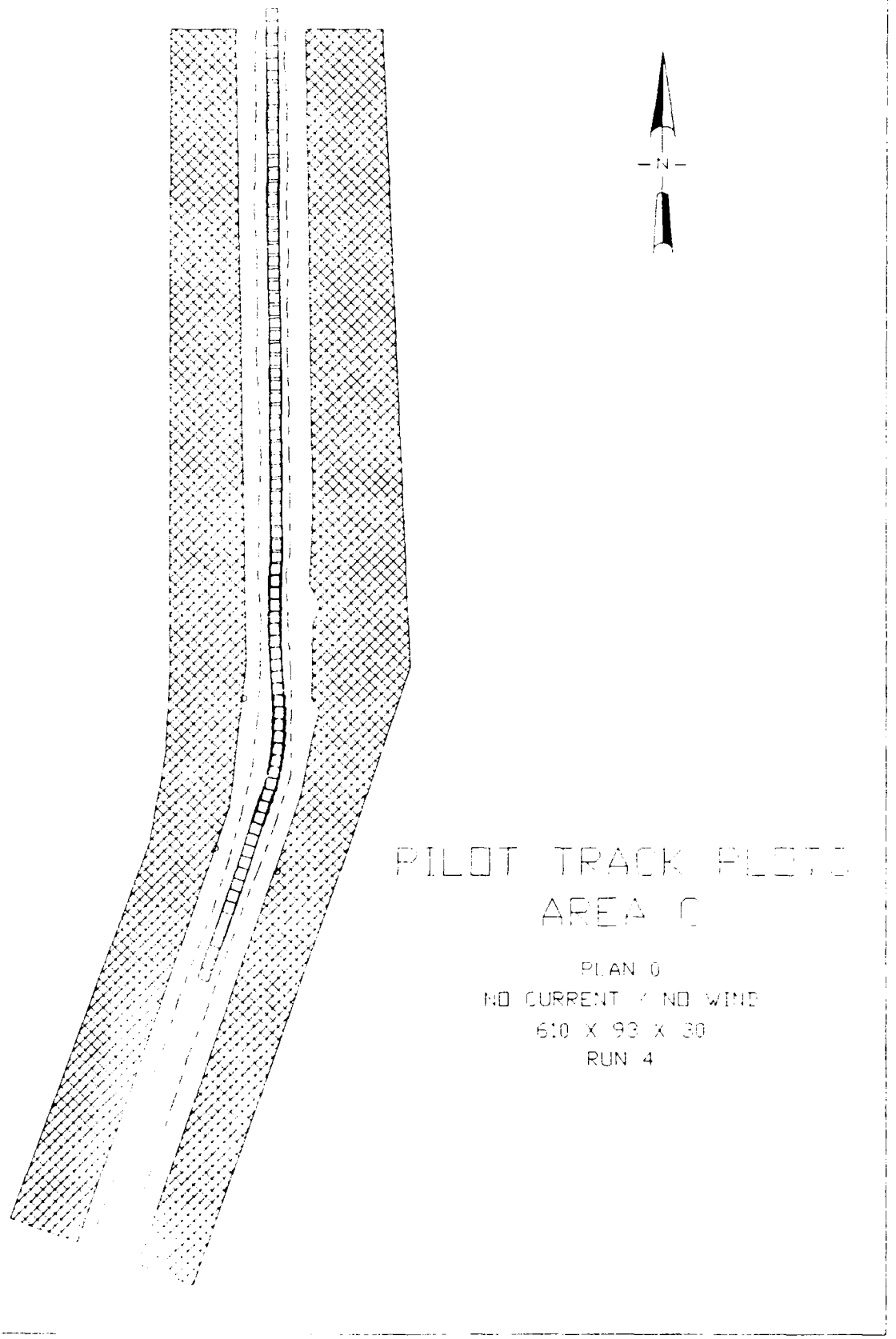
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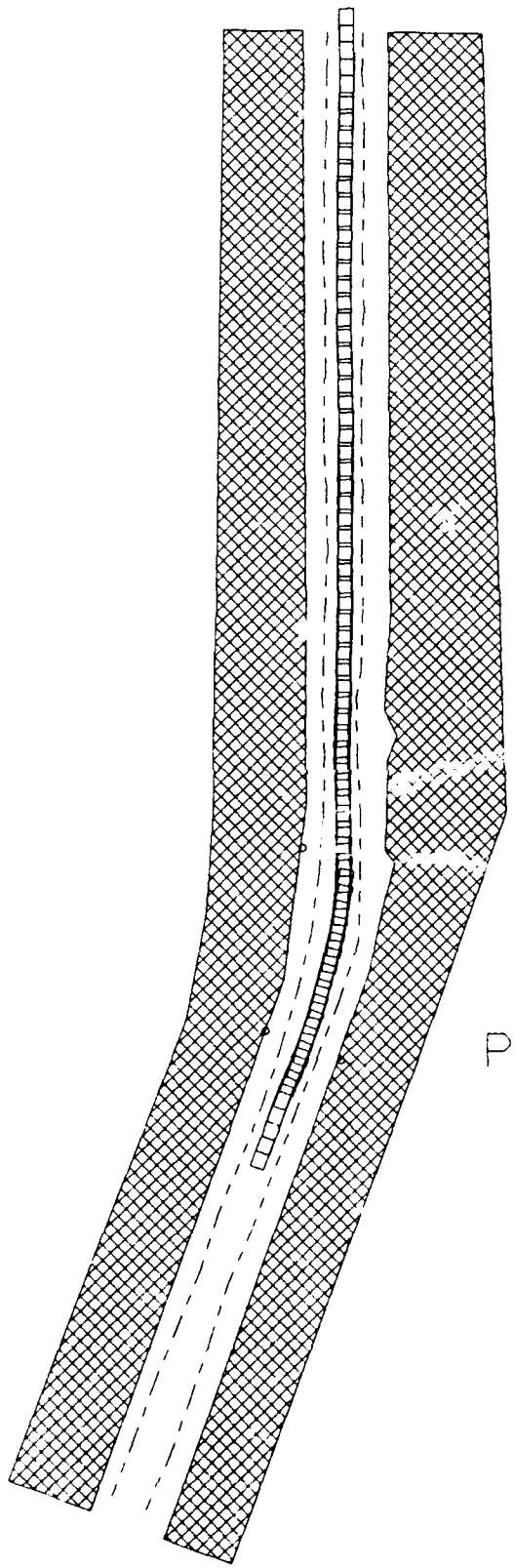
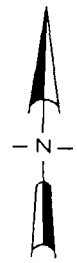
PILOT TRACK PLOTS
AREA C
PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 4

PLATE B27

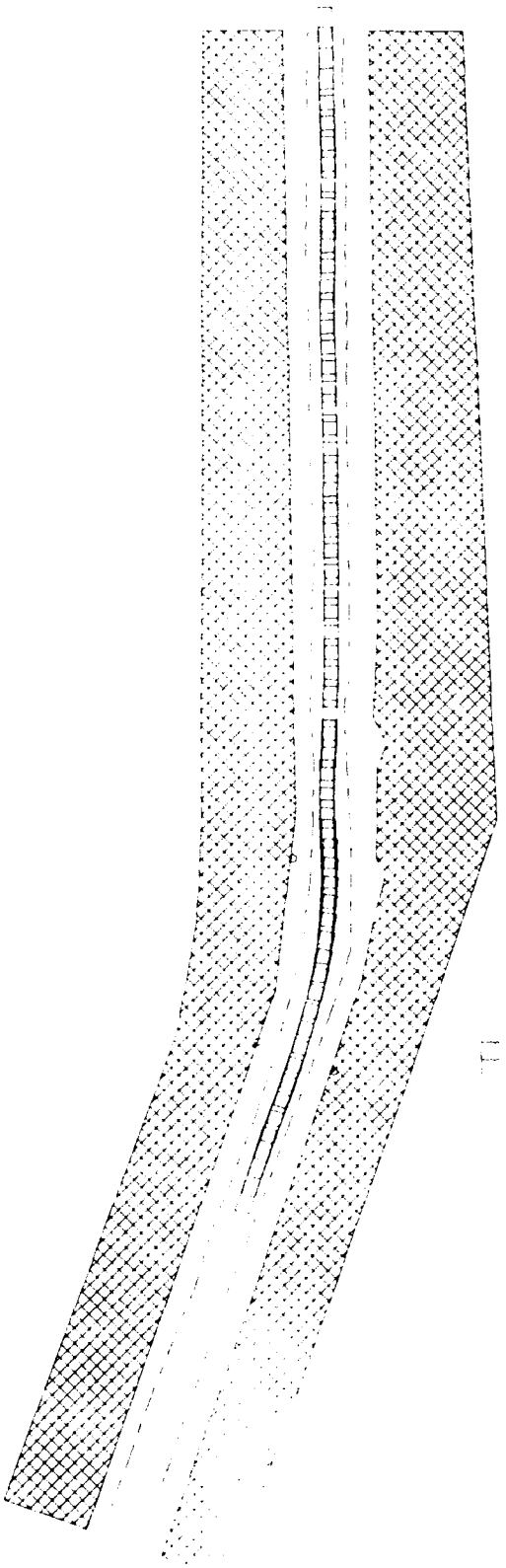




PILOT TRACK PLOTS
AREA C

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 5

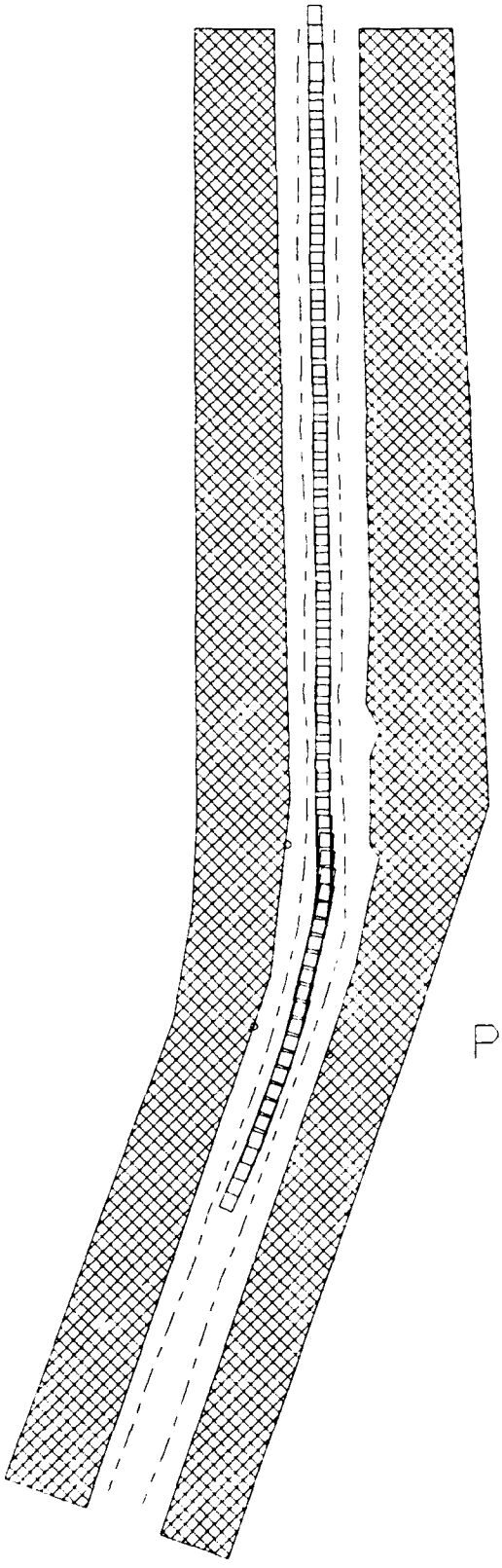
PLATE B23

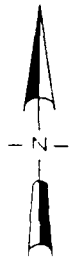


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 30
RUN 6

PLATE B24

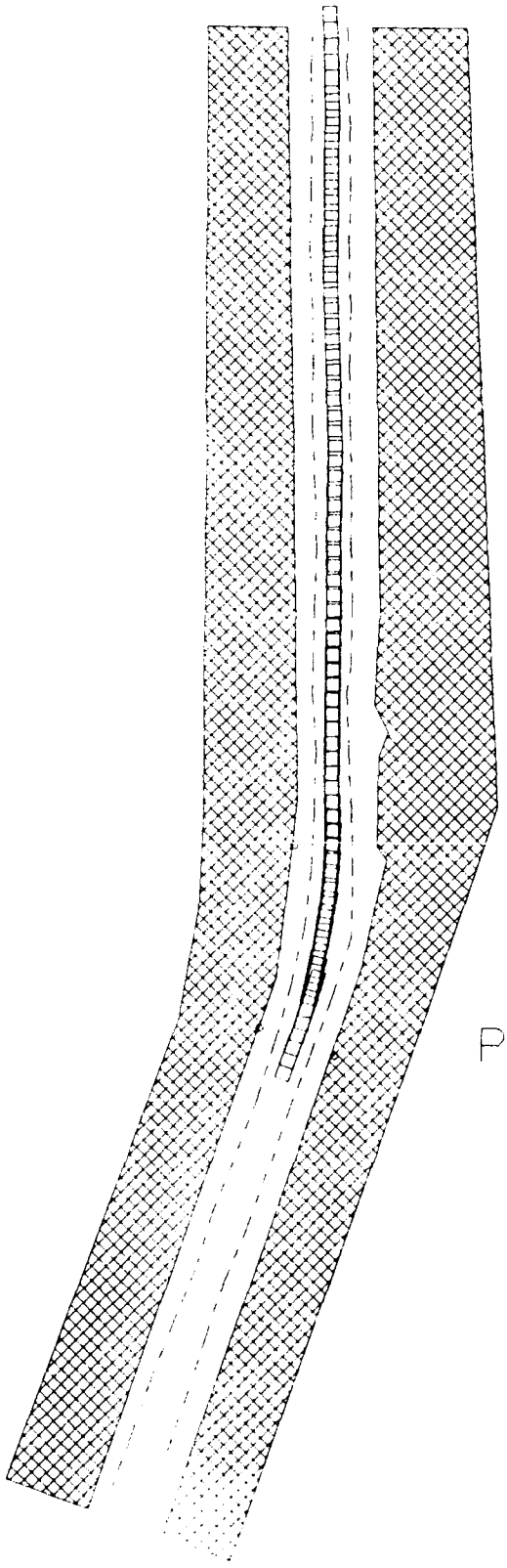


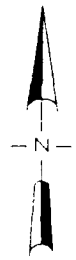


PILOT TRACK PLOTS
AREA C

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 7

PLATE B25

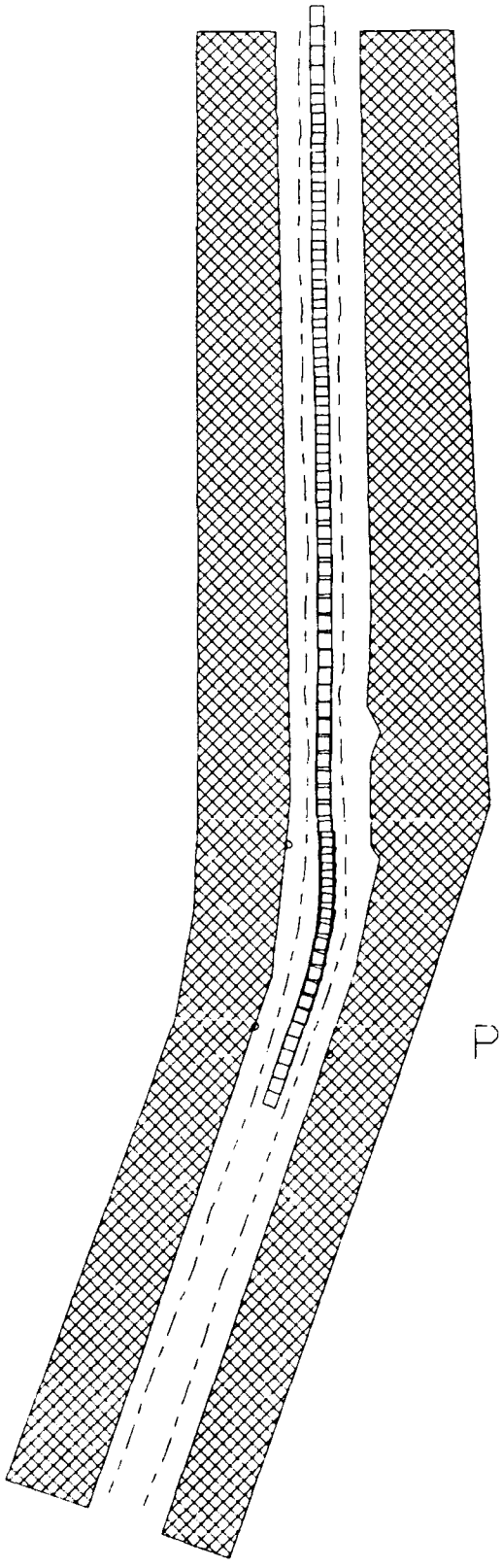


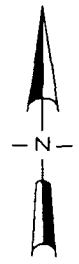


PILOT TRACK PLOTS
AREA C

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 8

PLATE B26



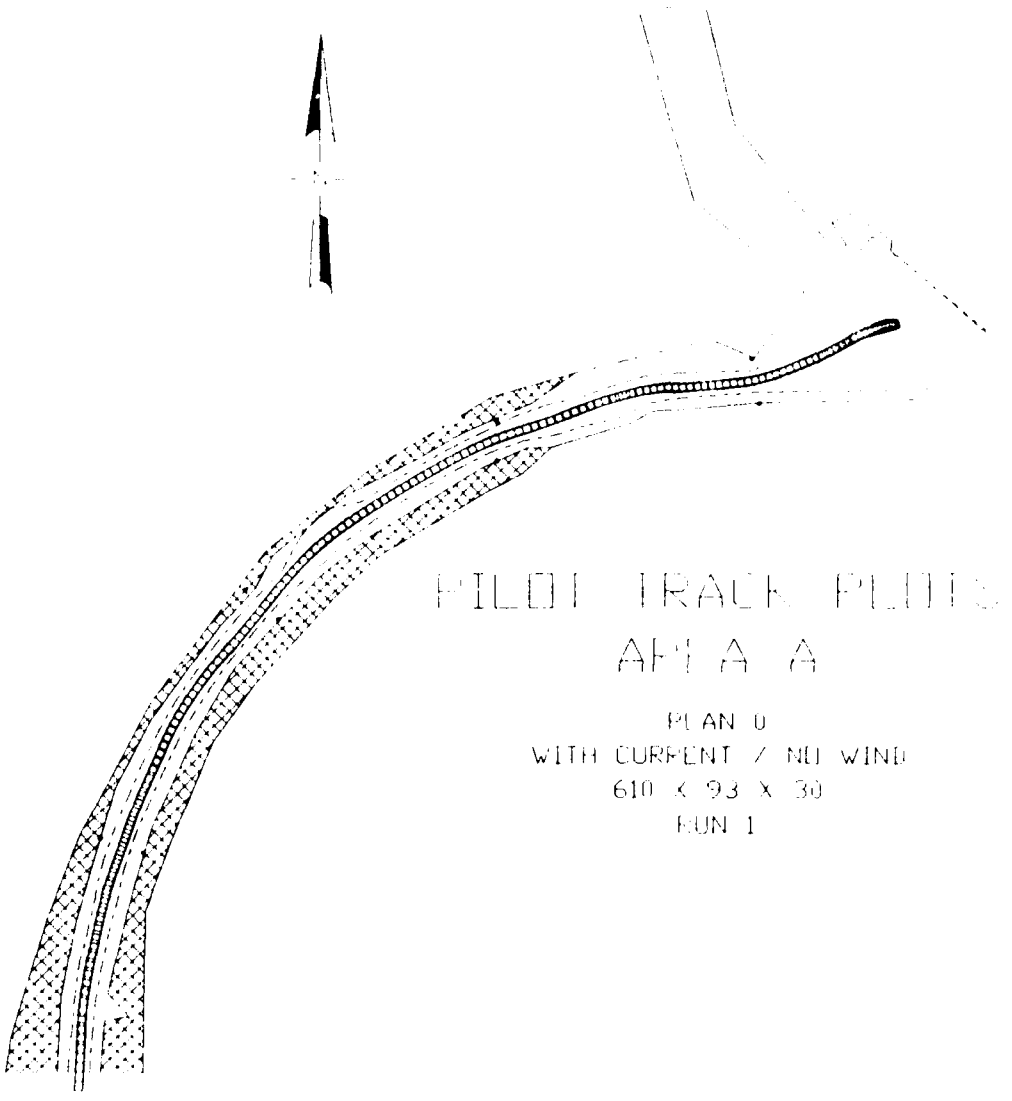


PILOT TRACK PLOTS
AREA C

PLAN 0
NO CURRENT / NO WIND
610 X 93 X 30
RUN 9

PLATE B27

PLATE B28



PILOT TRACK PLOTS

APIA A

PLAN D

WITH CURRENT / NO WIND

610 X 93 X 30

RUN 1

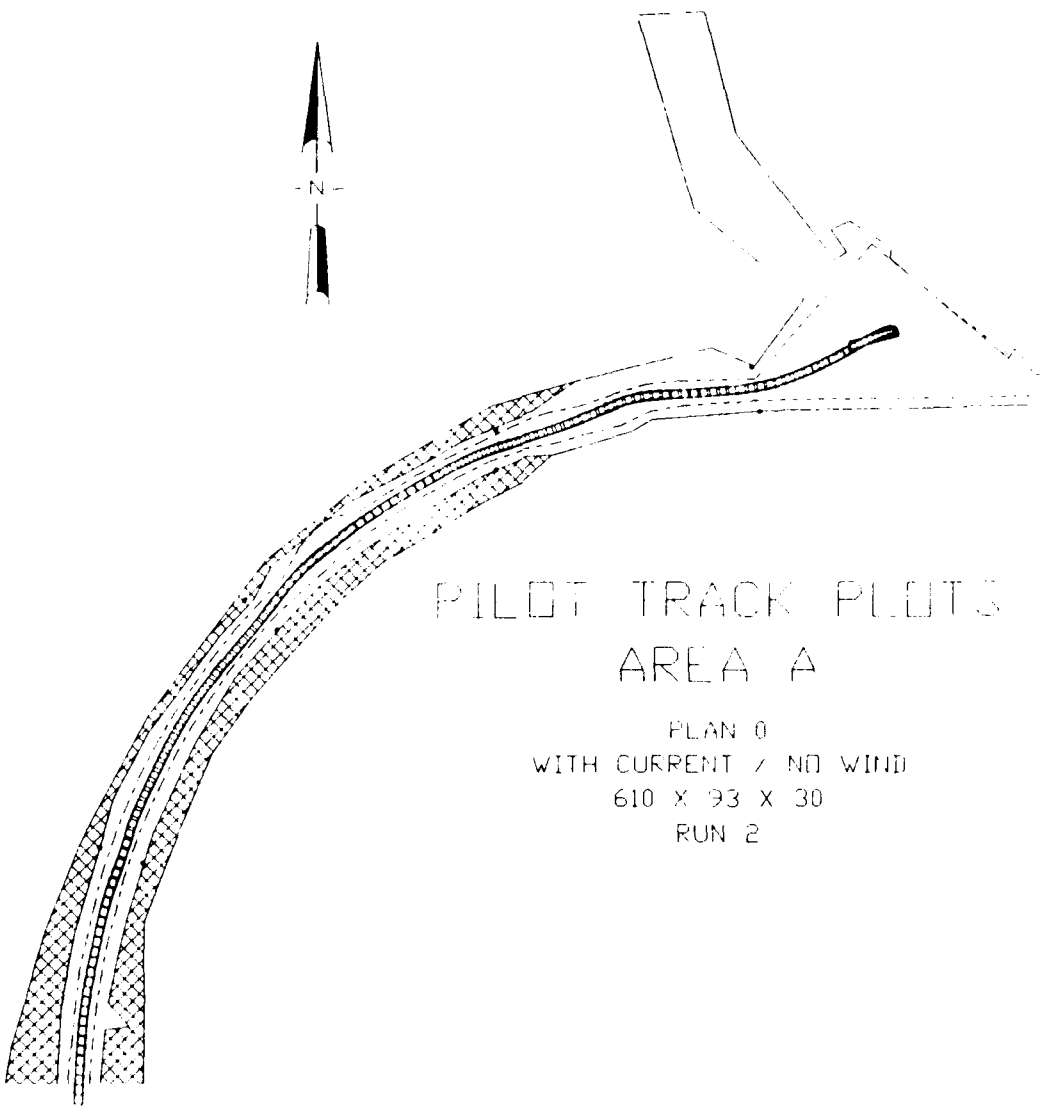
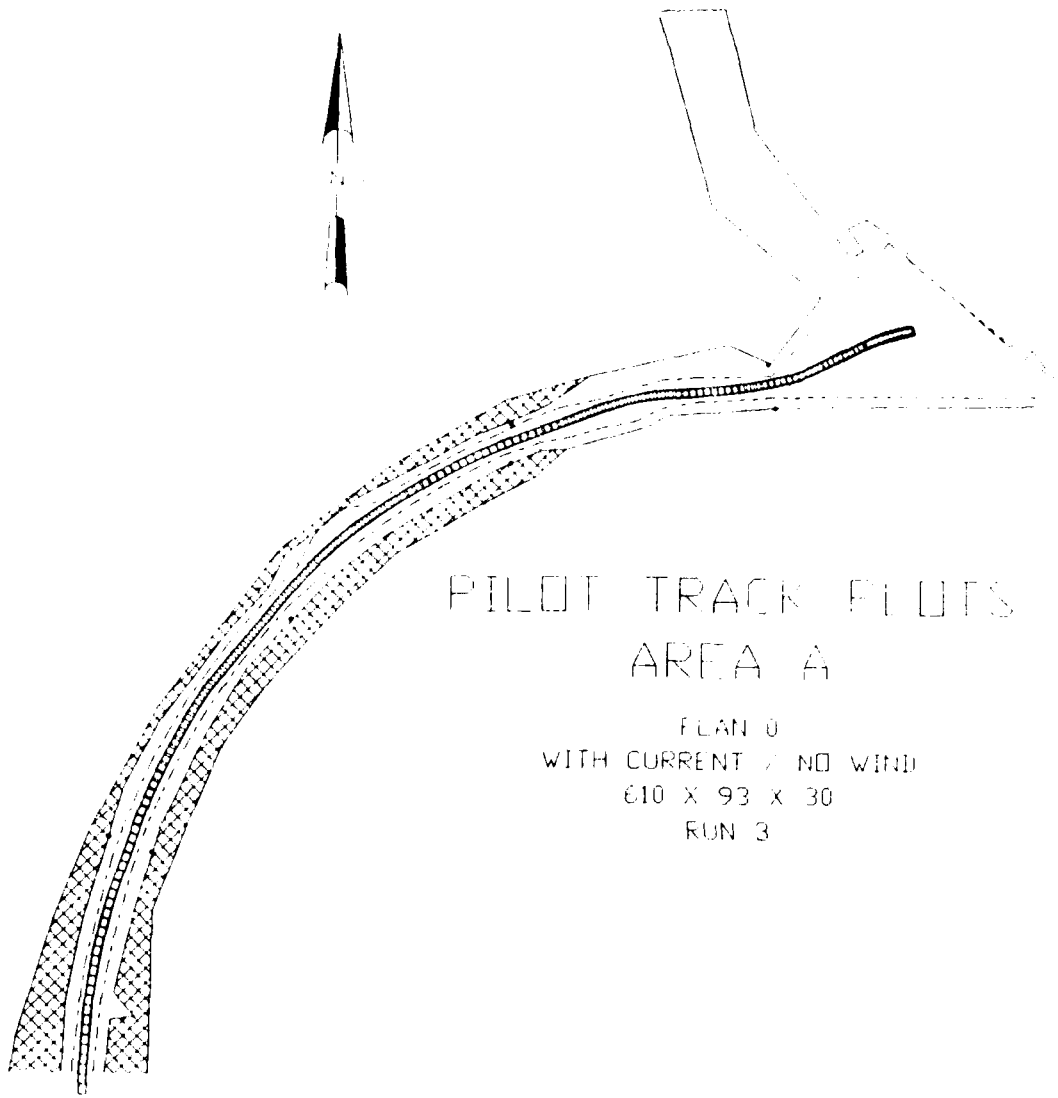

N
PILOT TRACK PLOTS
AREA A
PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 2

PLATE B29

PLATE B30



PILOT TRACK PLOTS

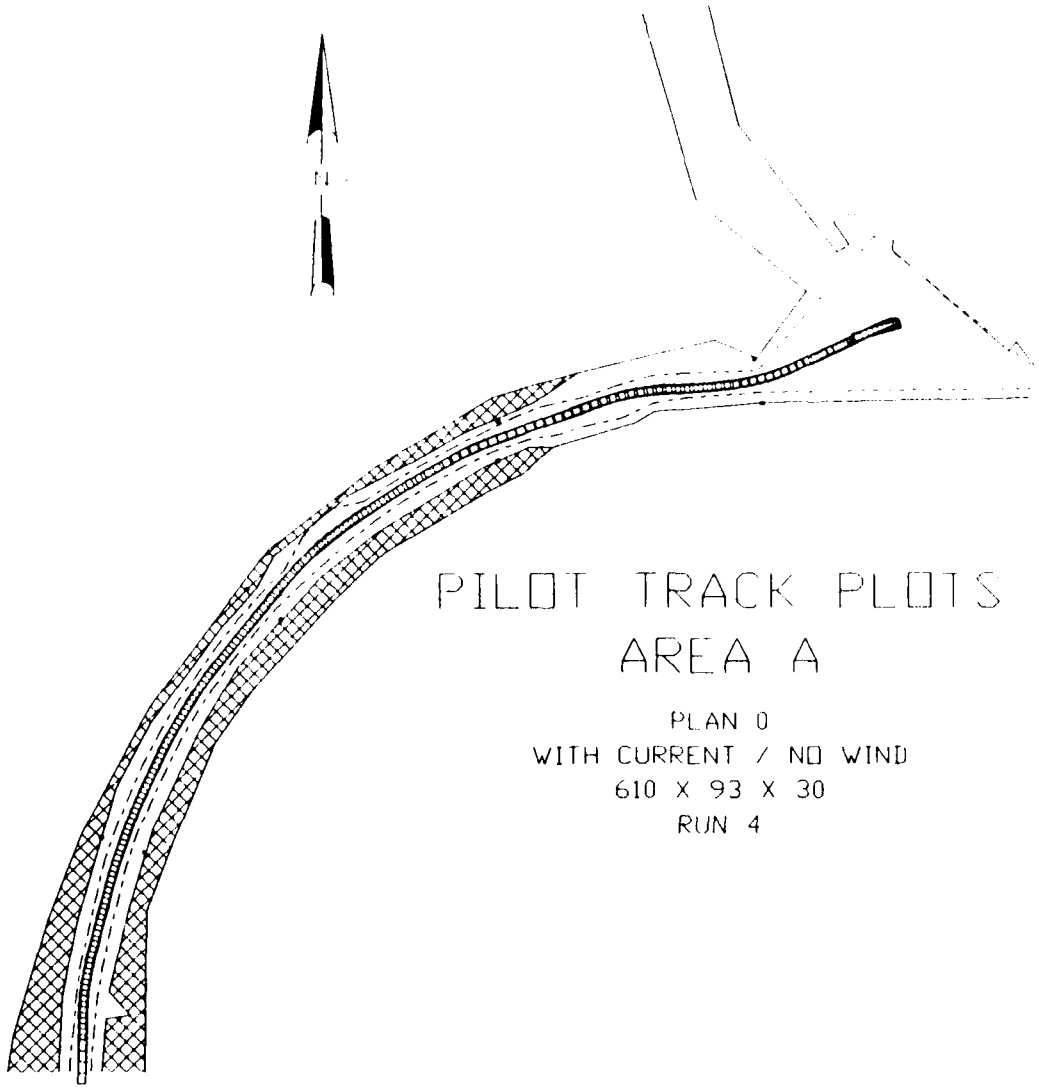
AREA A

PLAN 0

WITH CURRENT / NO WIND

610 X 93 X 30

RUN 3

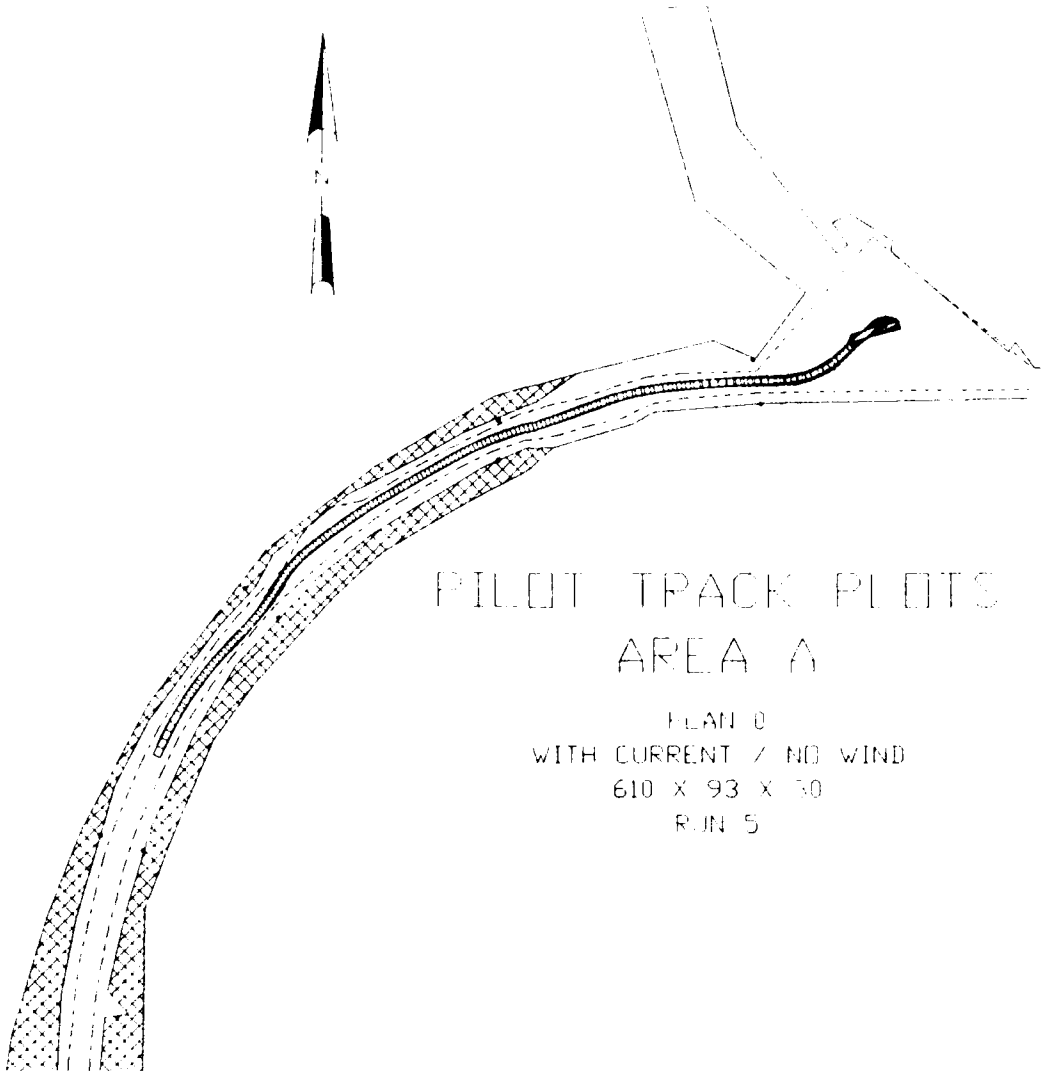


PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 4

PLATE B31

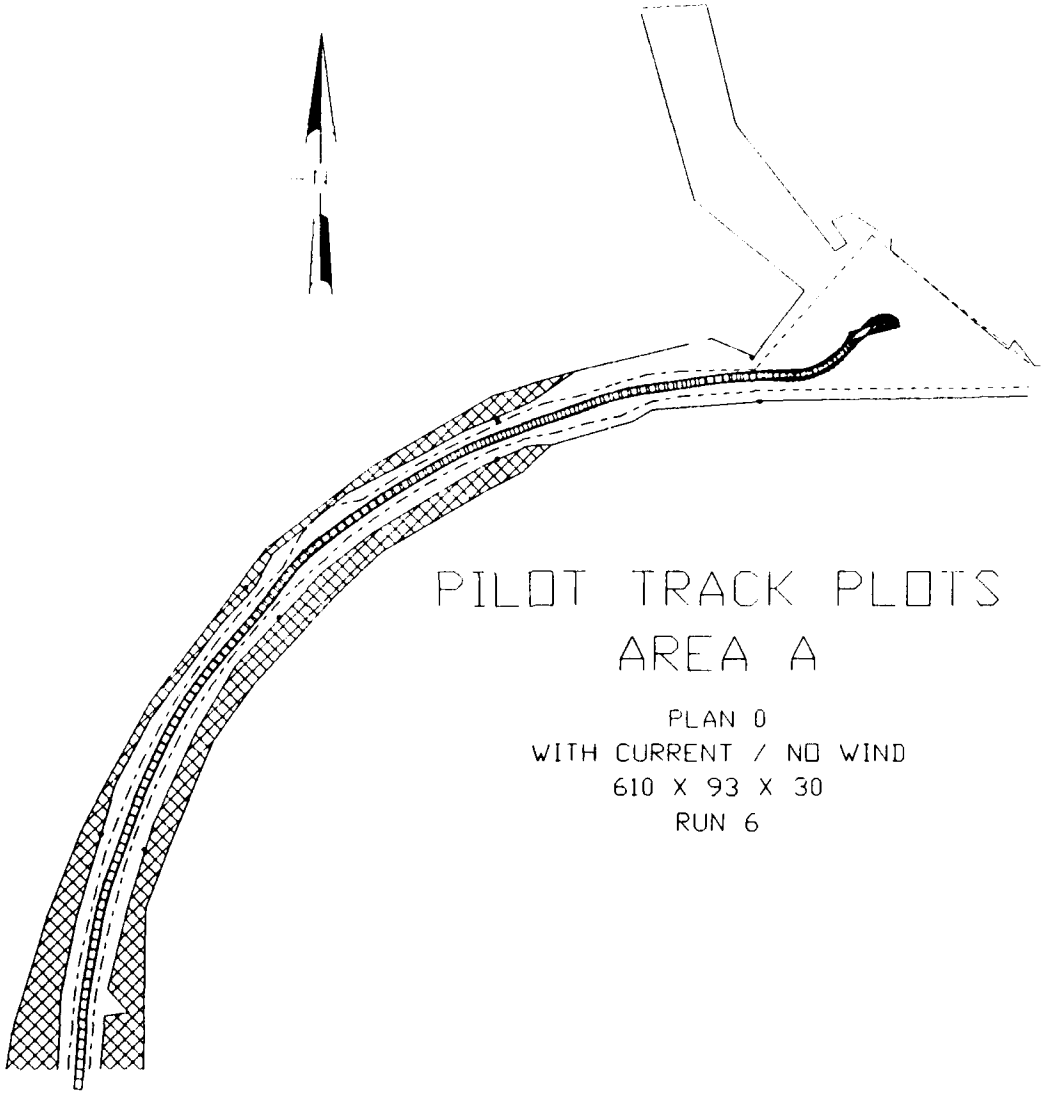
PLATE B32



PILOT TRACK PLOTS

AREA A

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 5

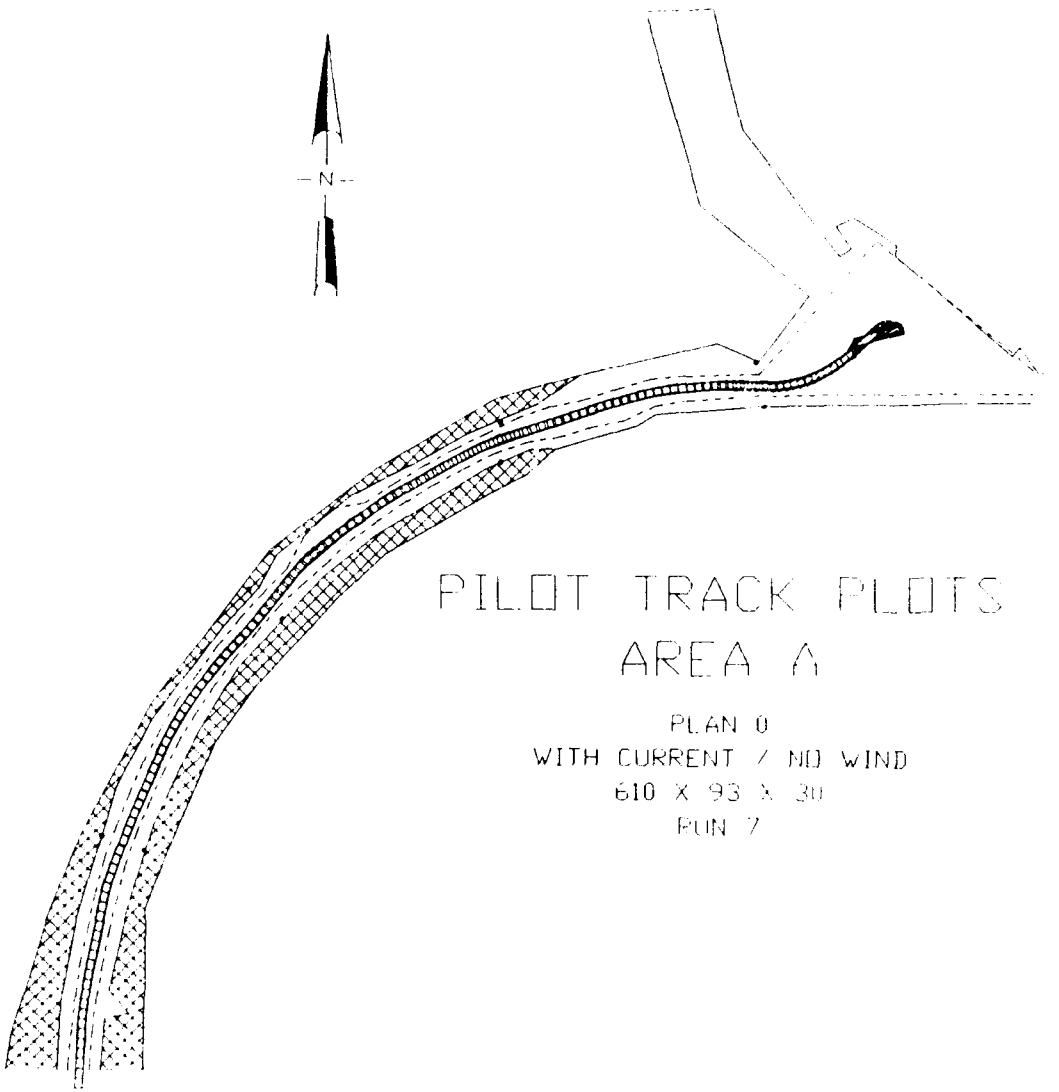


PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 6

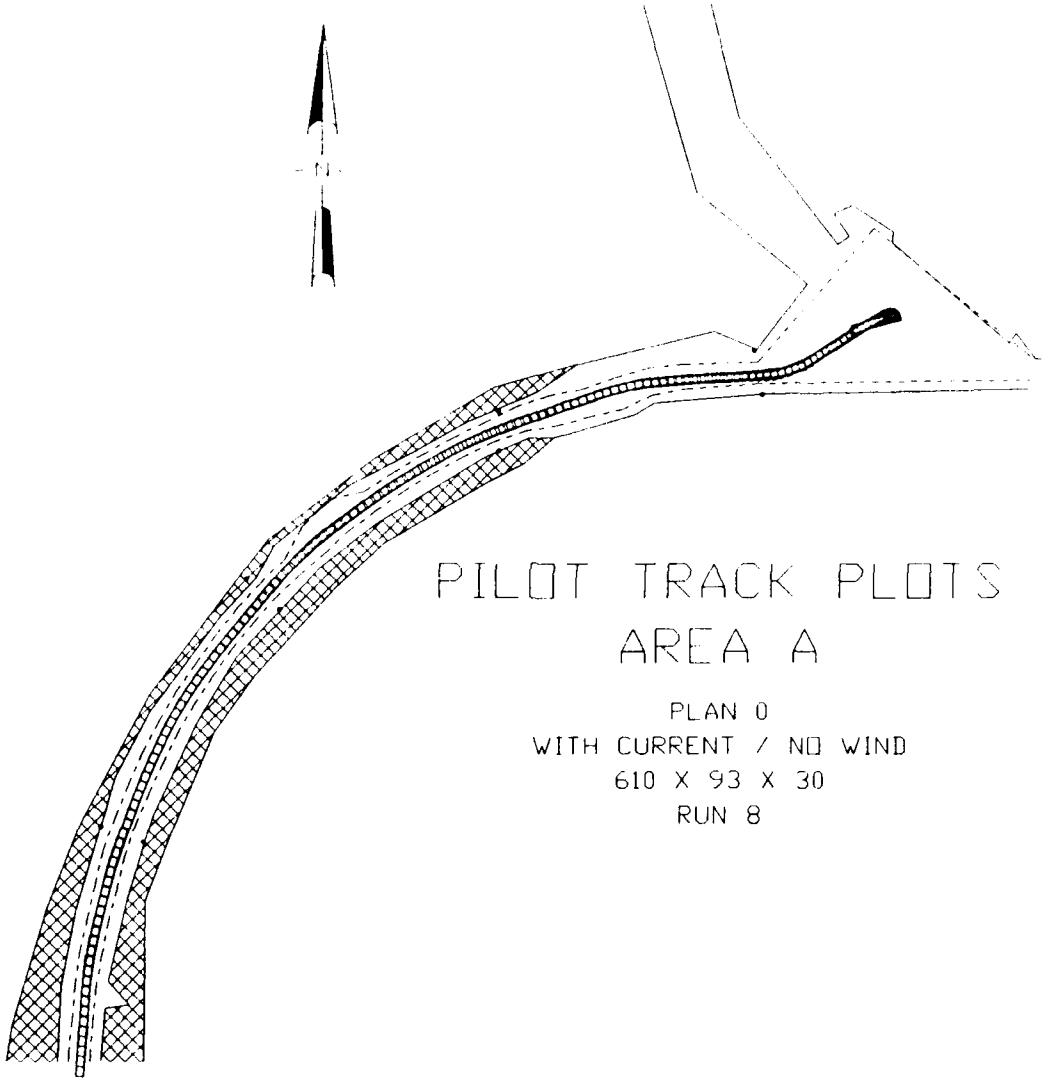
PLATE B33

PLATE B34



PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 7



PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 8

PLATE B35

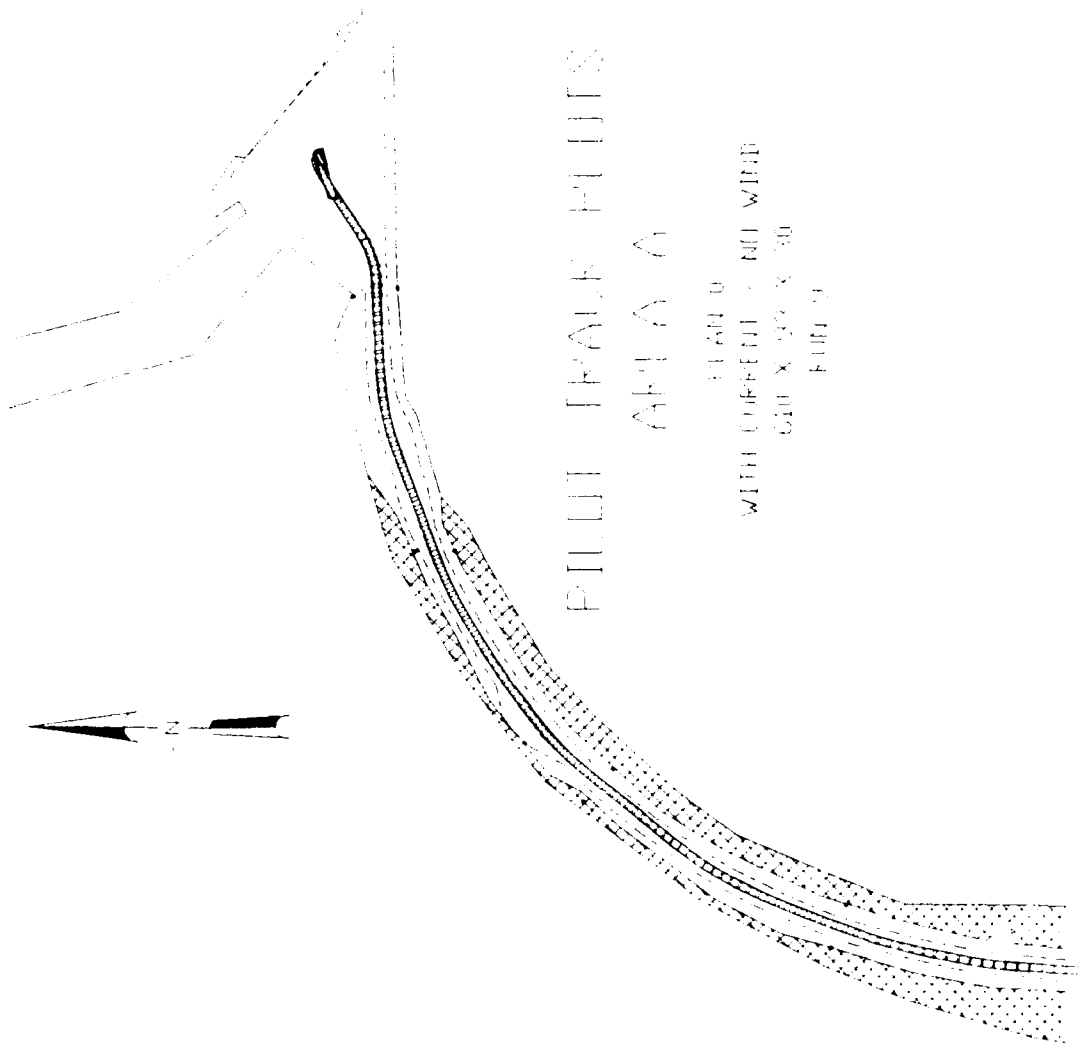
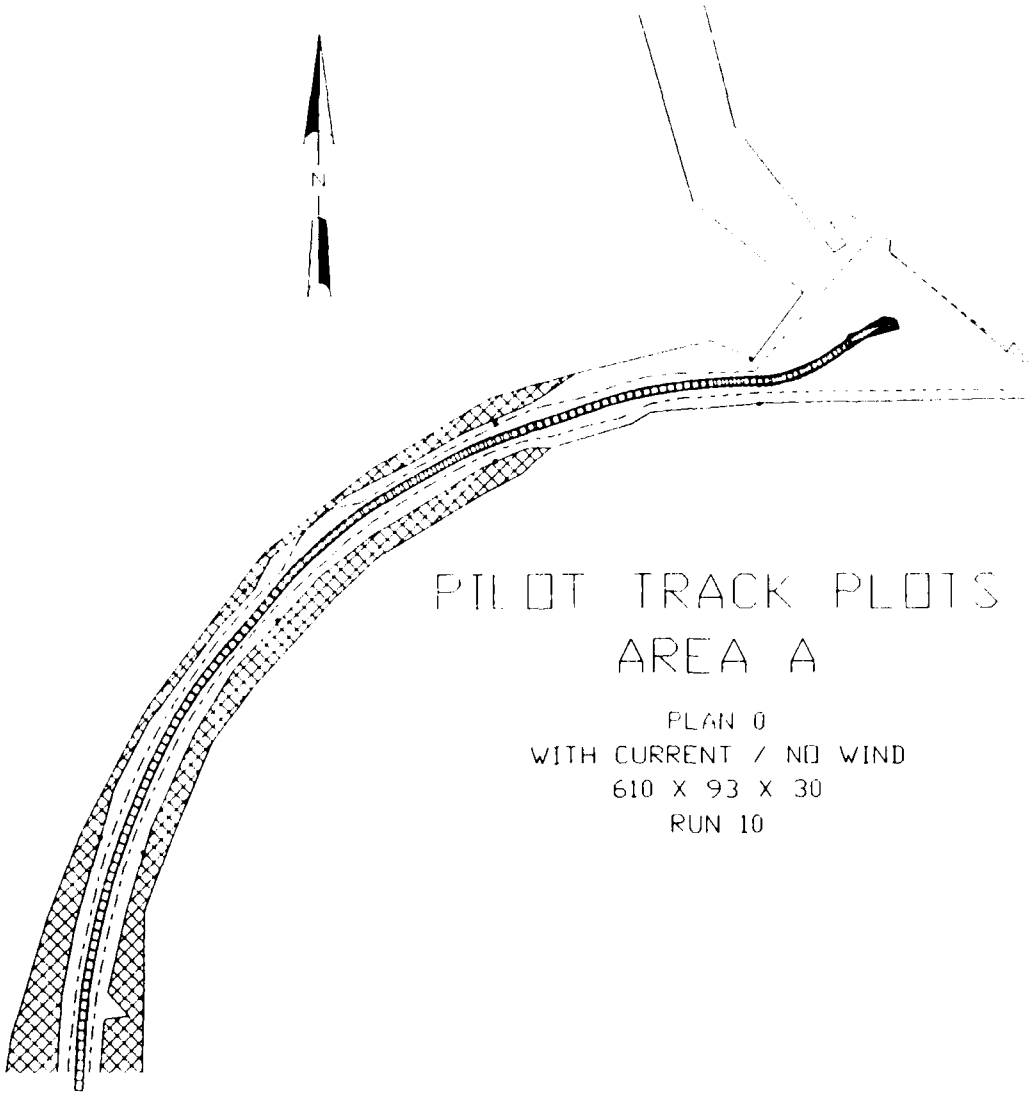


PLATE B36



PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 10

PLATE B37

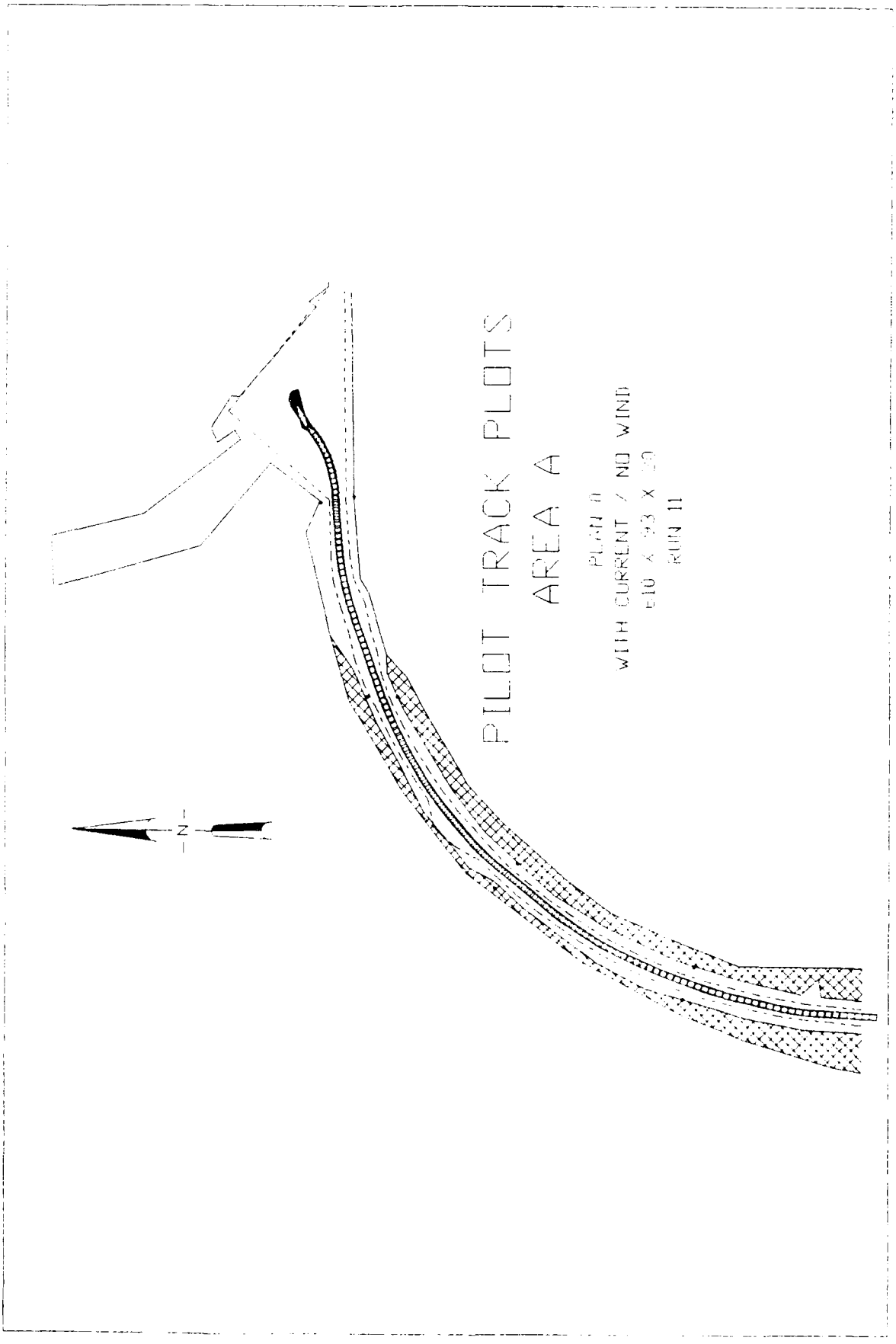
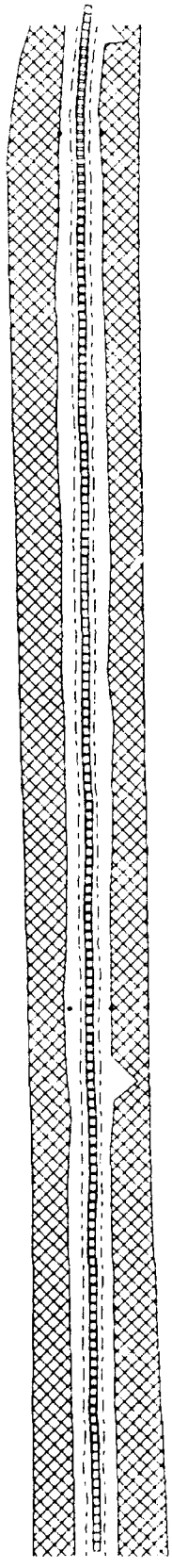
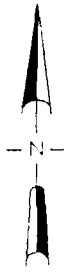


PLATE B38

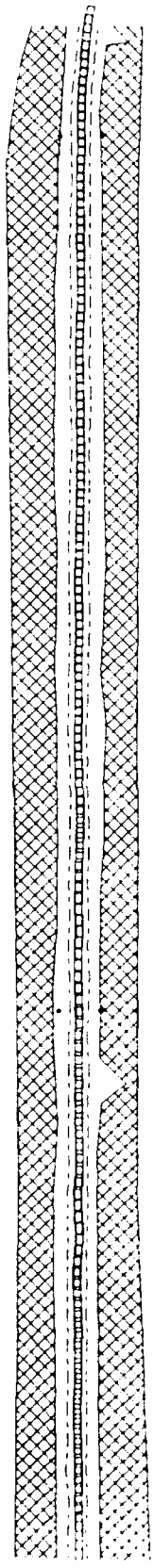


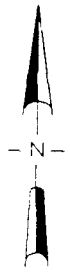


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 1

PLATE B39



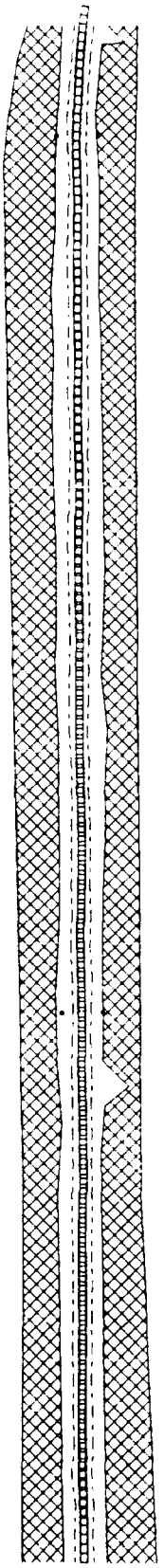


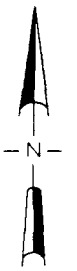
PILOT TRACK PLOTS

AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 2

PLATE B40

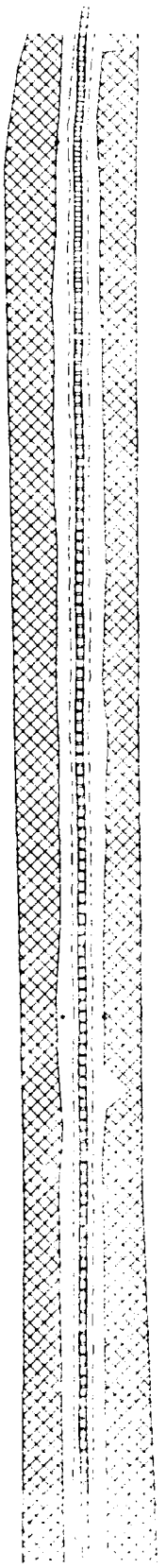


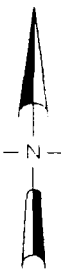


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 3

PLATE B41

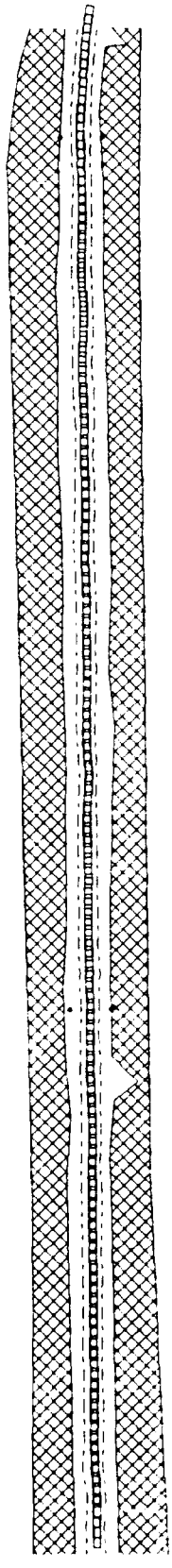


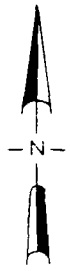


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 4

PLATE B42



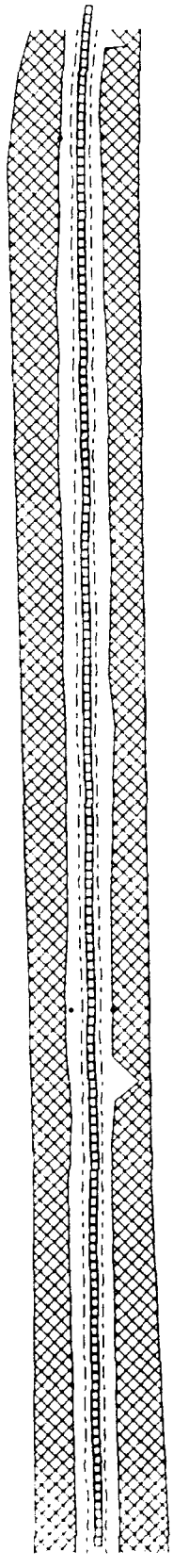


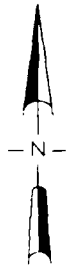
PILOT TRACK PLOTS

AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 6

PLATE B43

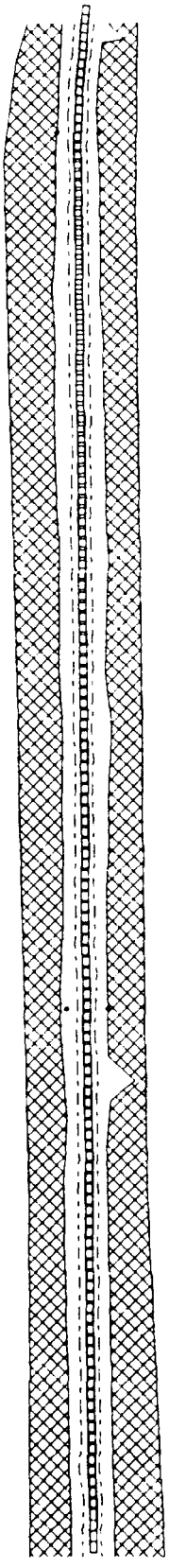


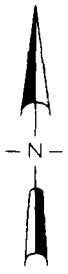


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 7

PLATE B44

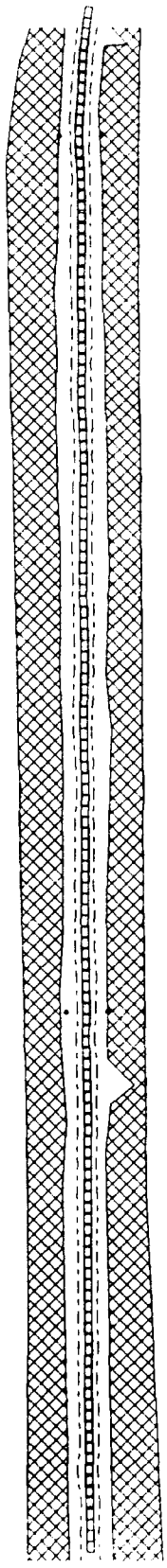


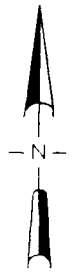


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 8

PLATE B45

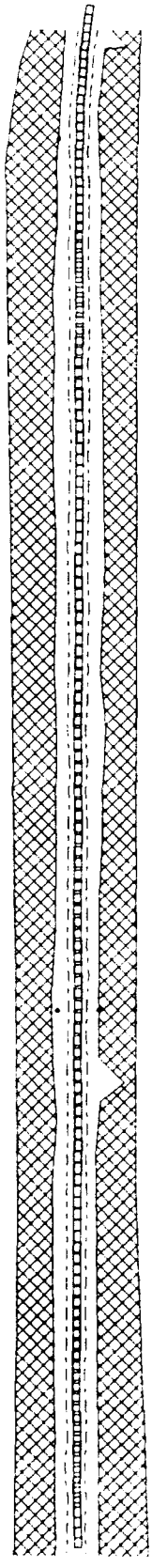


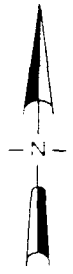


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 9

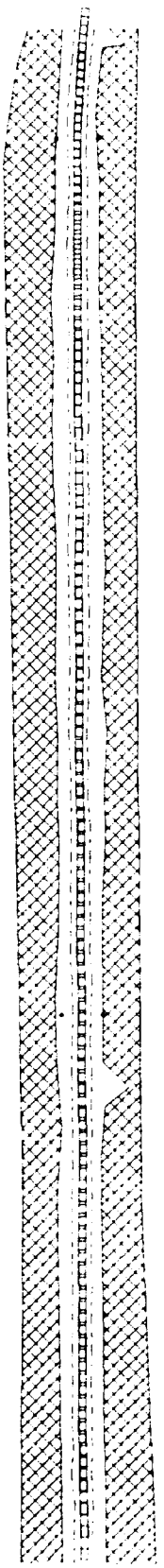
PLATE B46

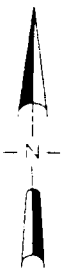




PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 10



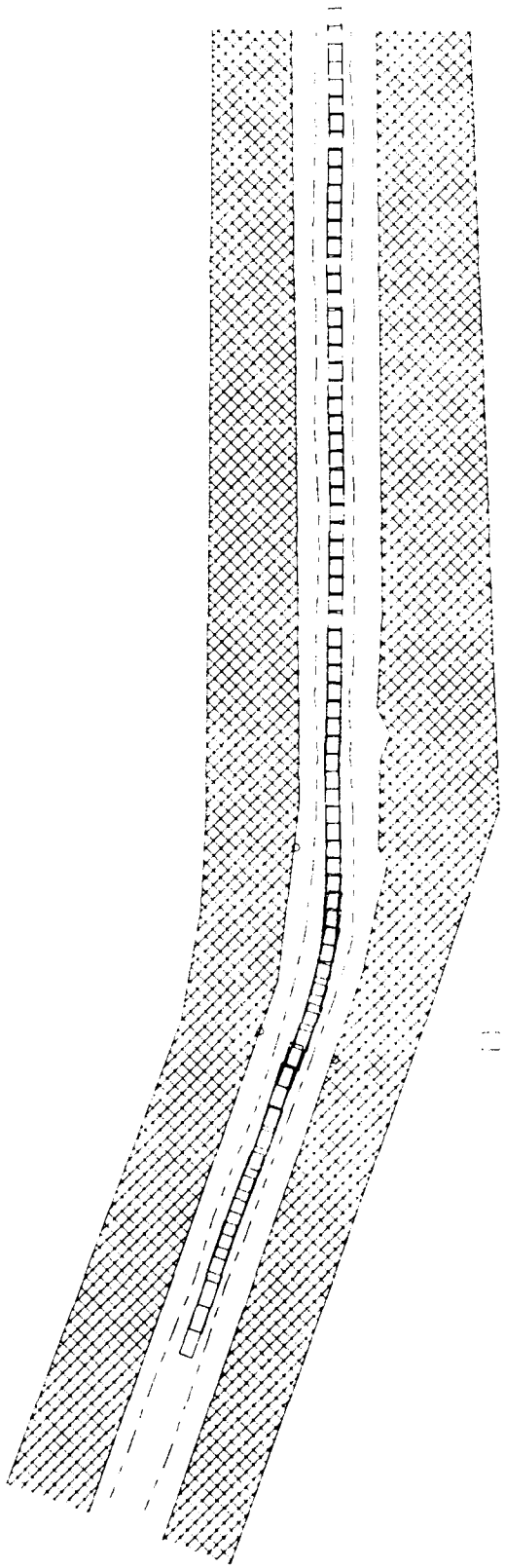


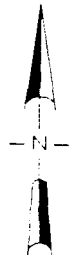
PILOT TRACK PLOTS

AREA B

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 11

PLATE B48





PILOT TRACK PLOT
AREA C

PLAN C
WITH CURRENT / NO WIND
510 X 93 X 30
RUN 1

PLATE B49

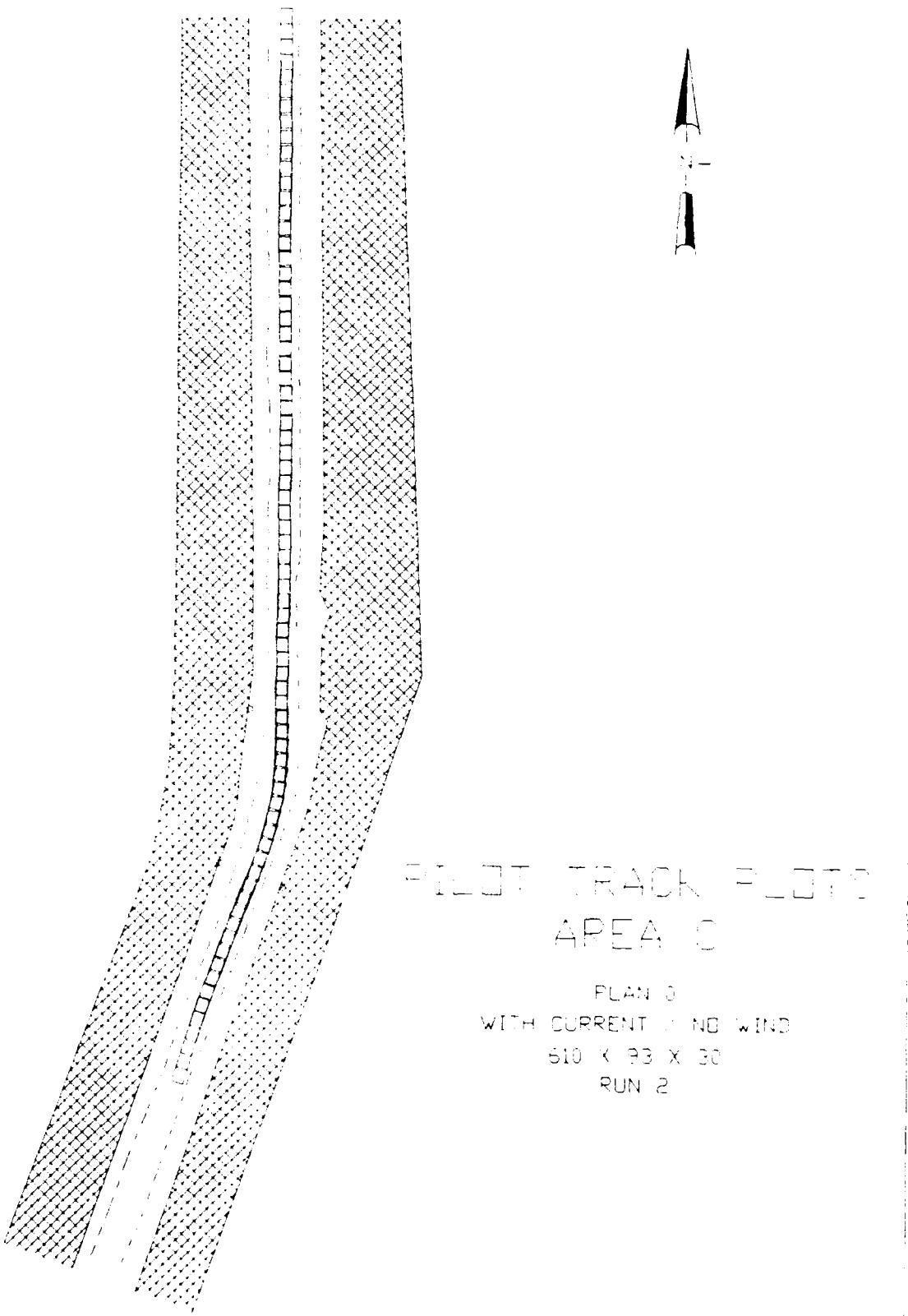
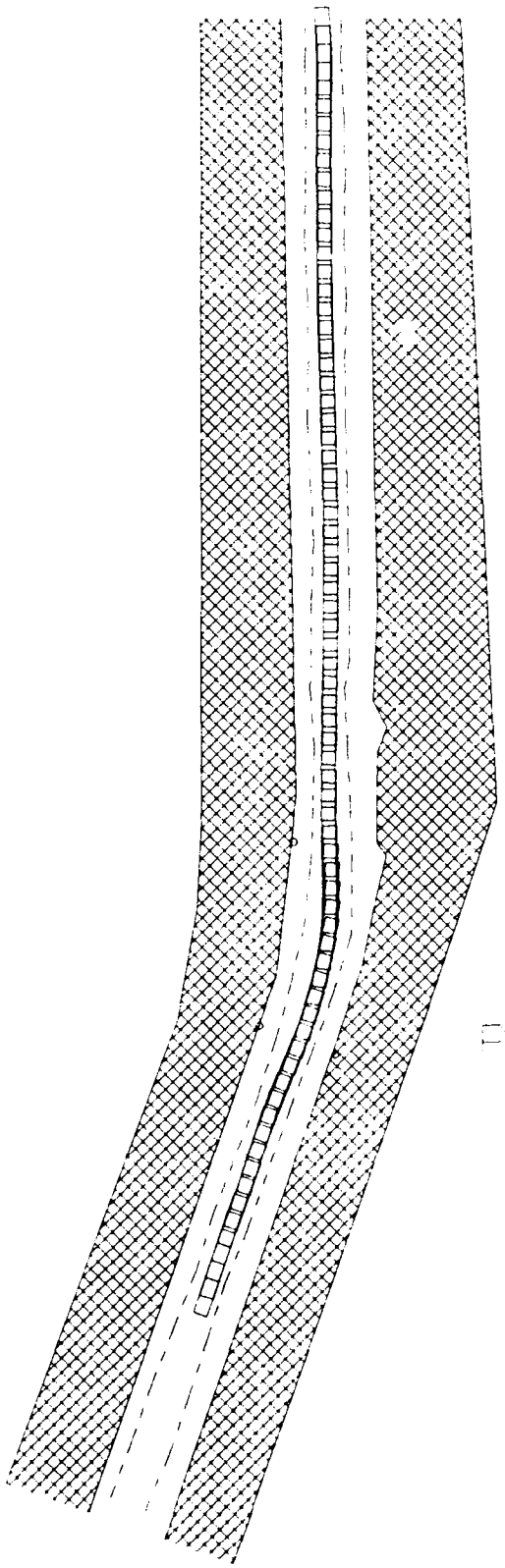
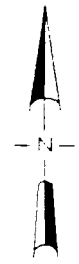

PILOT TRACK PLOTS
AREA C
PLAN 3
WITH CURRENT & NO WIND
510 X 93 X 30
RUN 2

PLATE B50





PILOT TRACK PLOT
AREA C

PLAN C
WITH CURRENT - NO WIND
610 X 93 X 30
RUN 3

PLATE B51

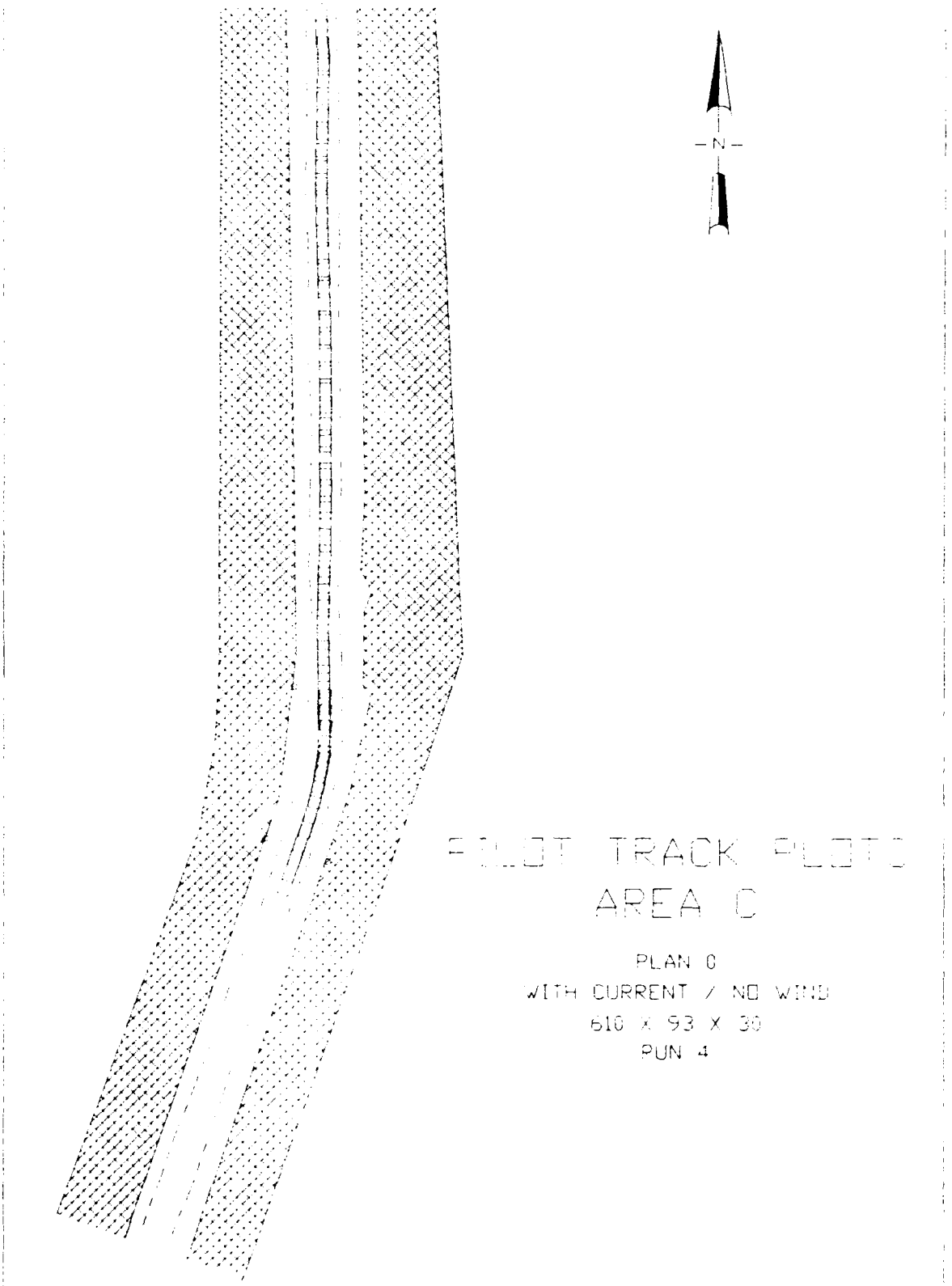
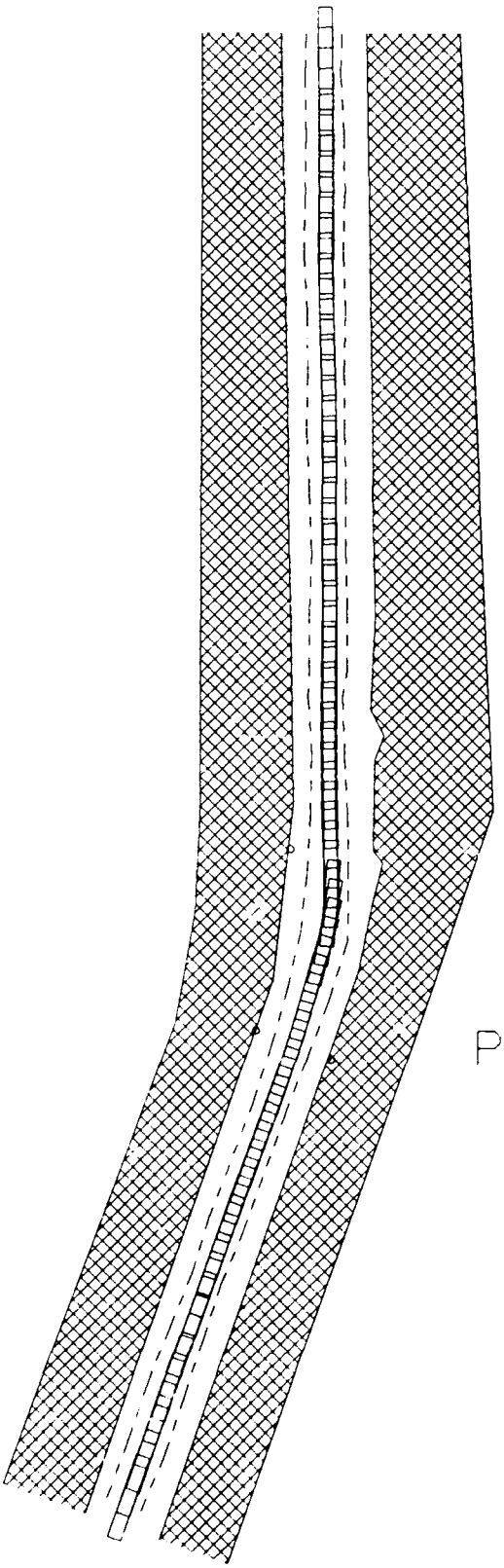
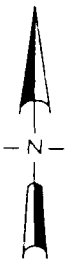

N
PILOT TRACK PLOT
AREA C
PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 4

PLATE B52

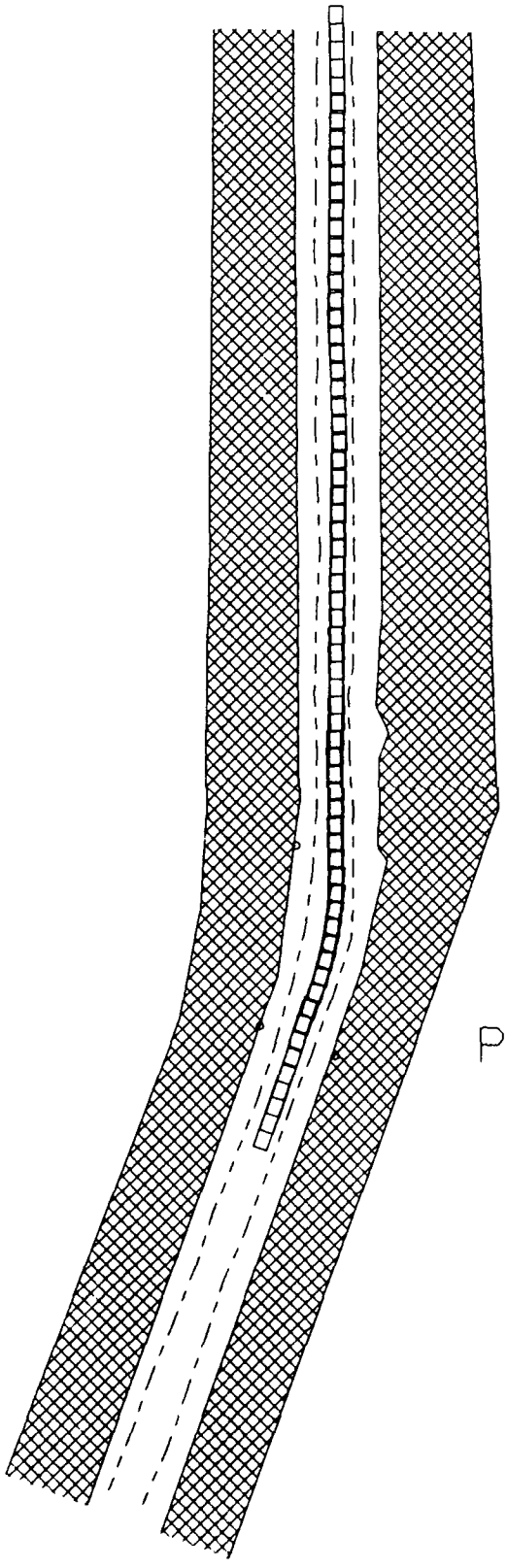


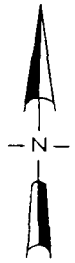


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 6

PLATE B53

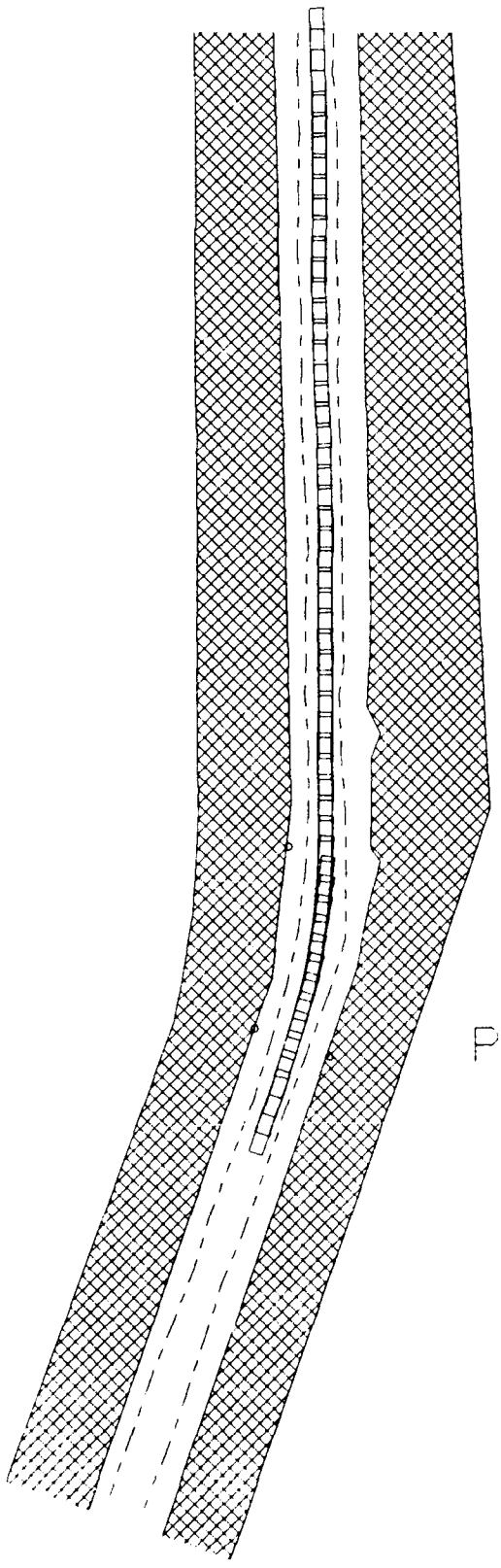




PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 7

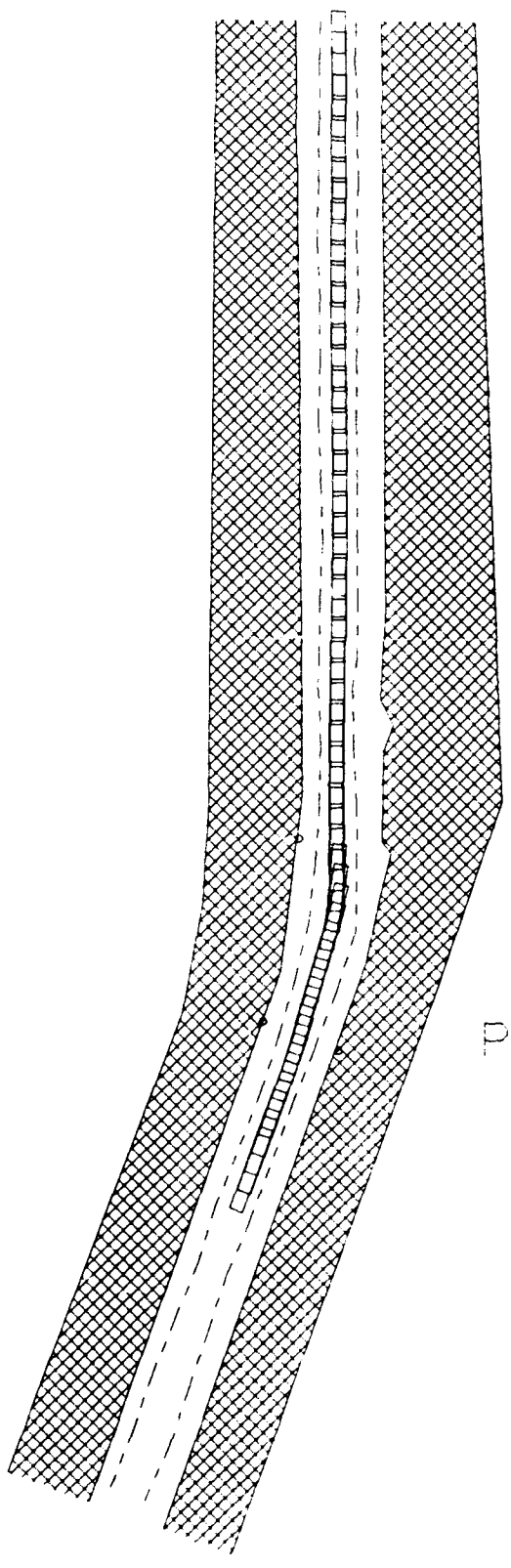
PLATE B54

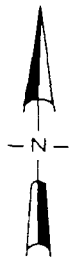


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 8

PLATE B55

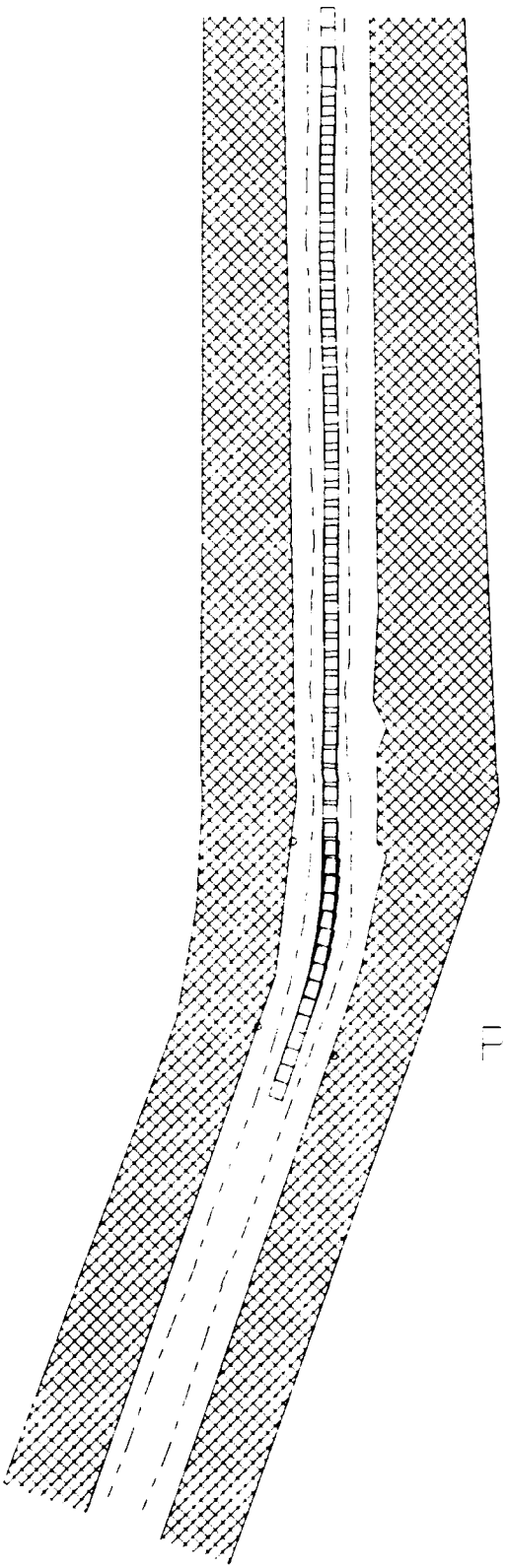


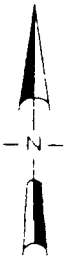


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 9

PLATE B56

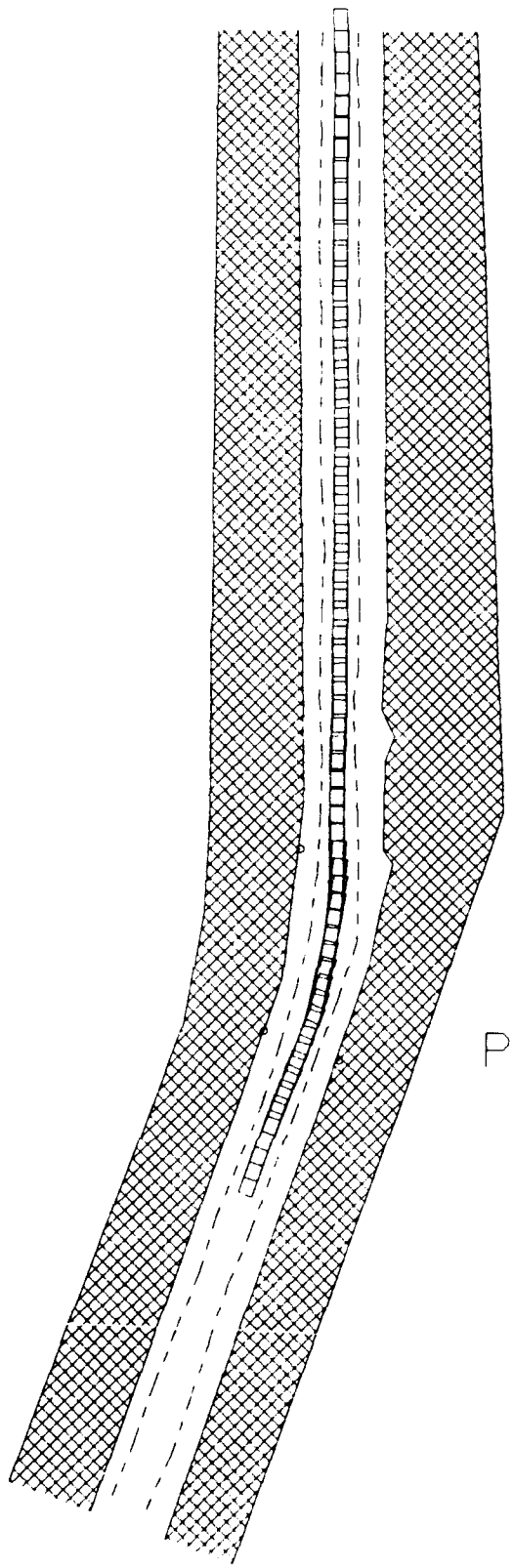


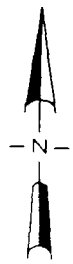


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 10

PLATE B57

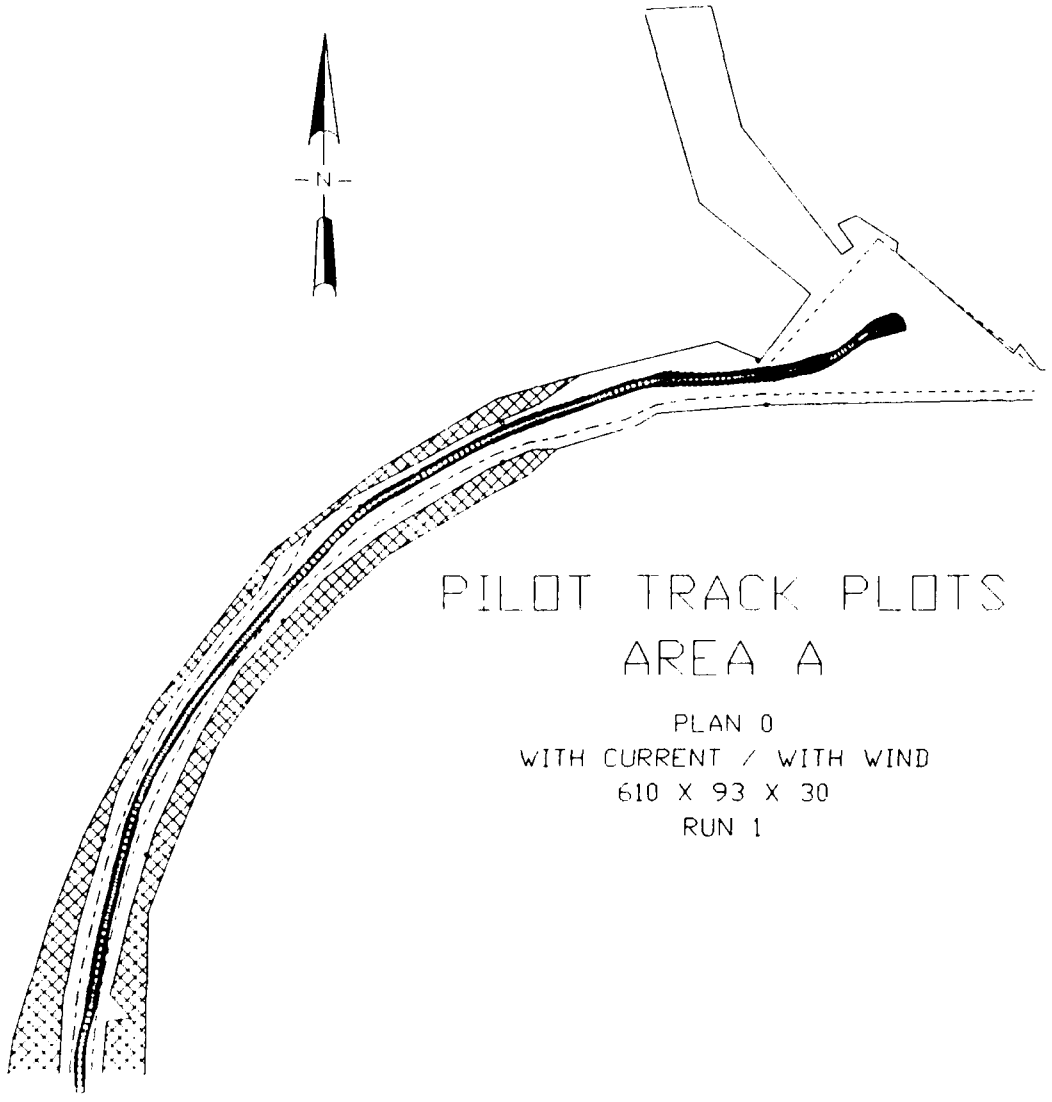




PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / NO WIND
610 X 93 X 30
RUN 11

PLATE B58

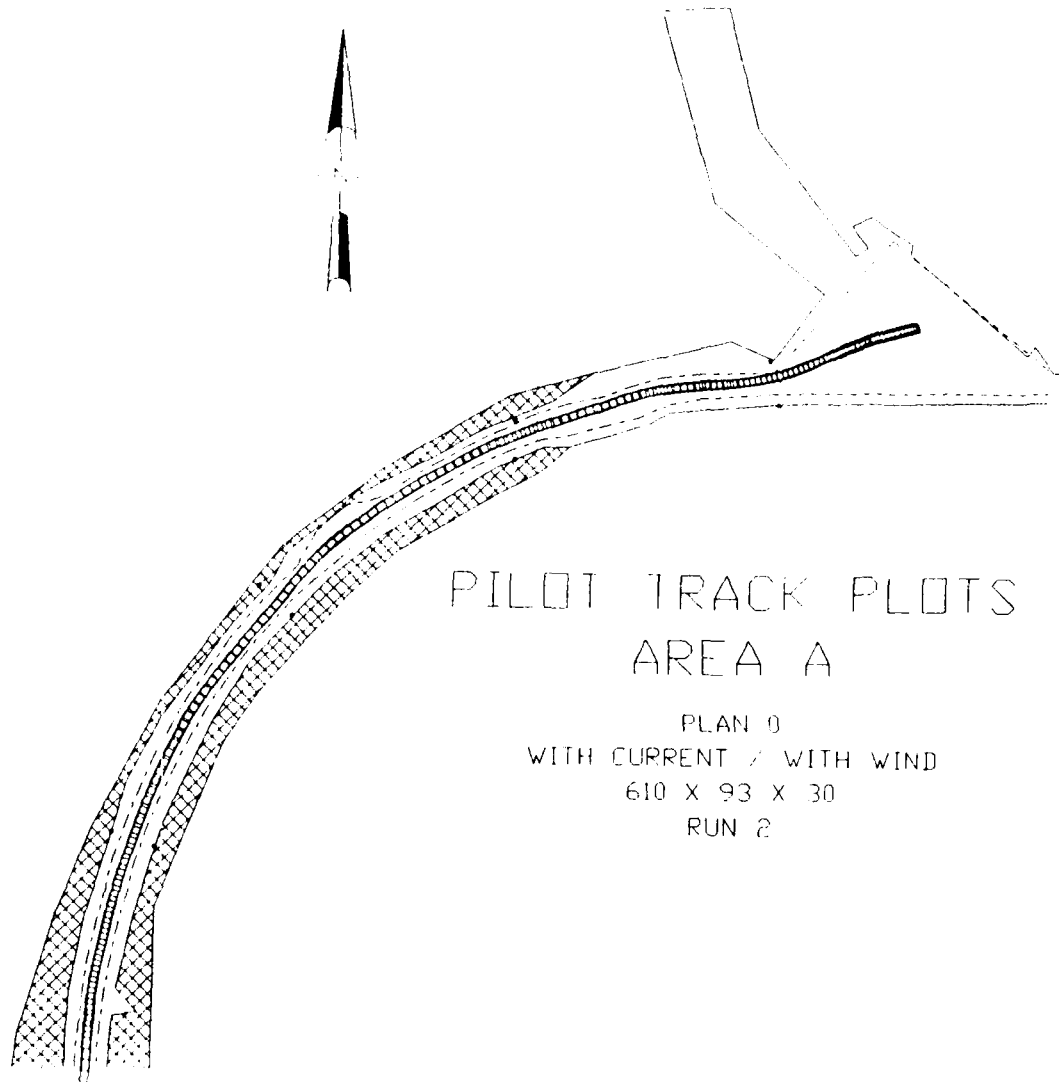


PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 1

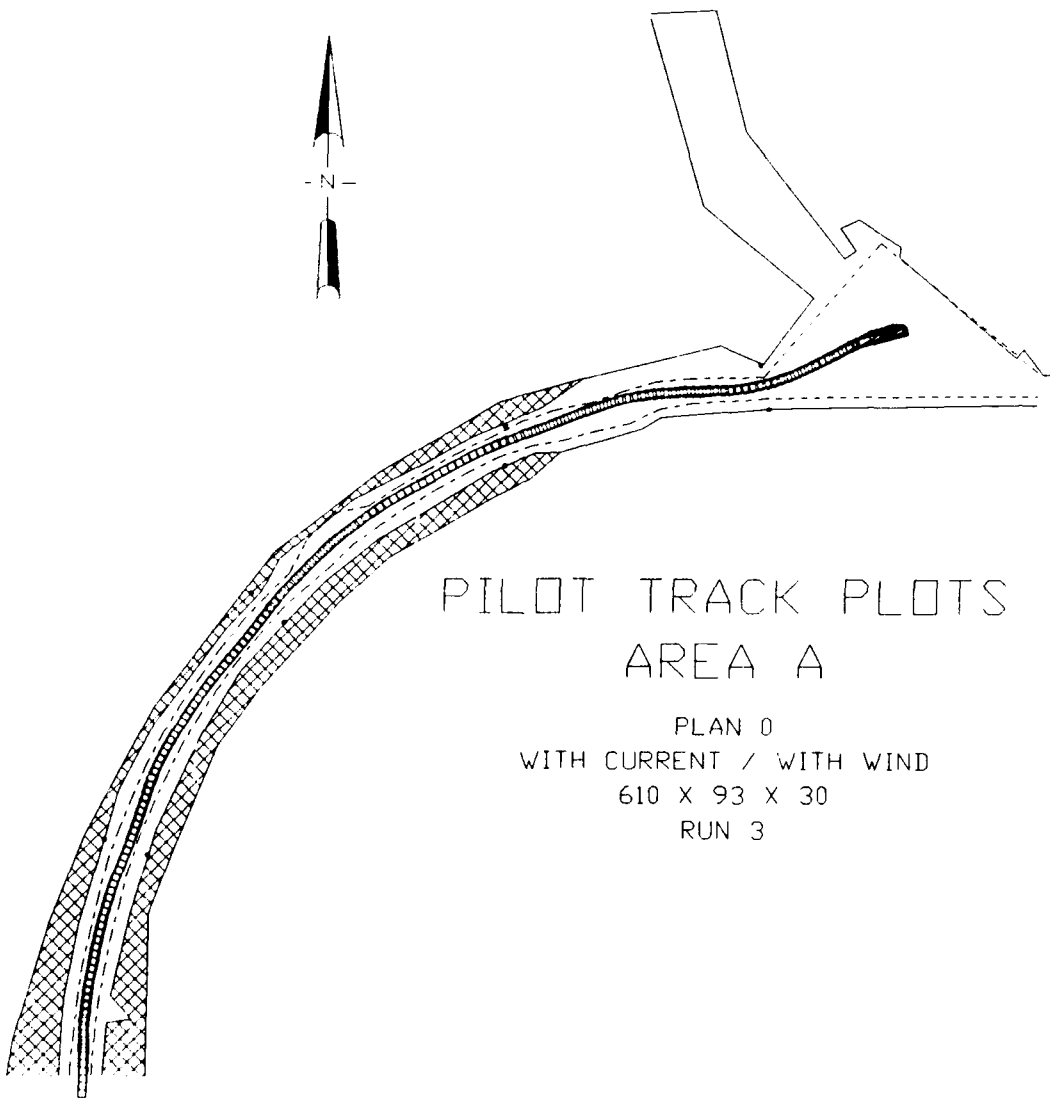
PLATE B59

PLATE B60



PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 2

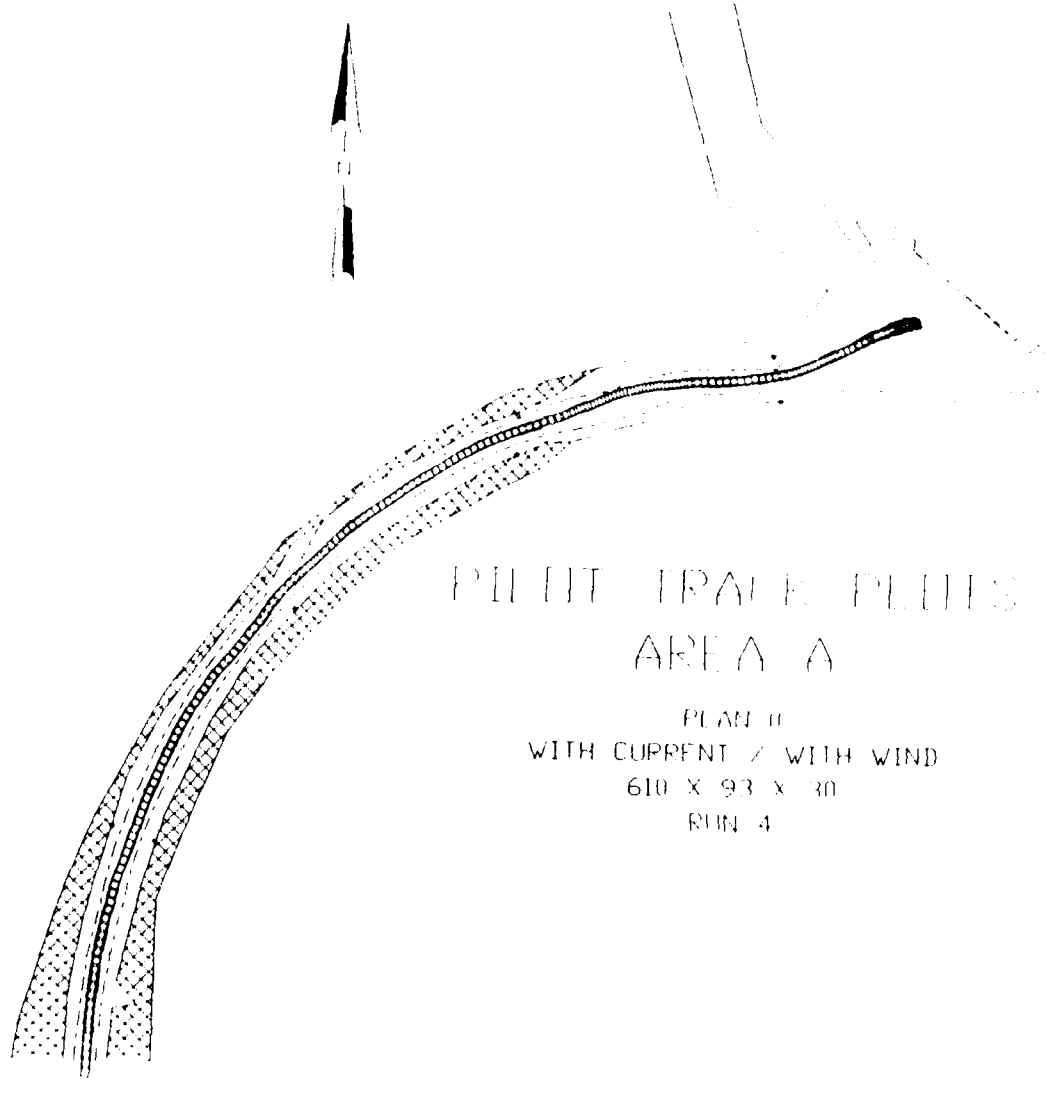


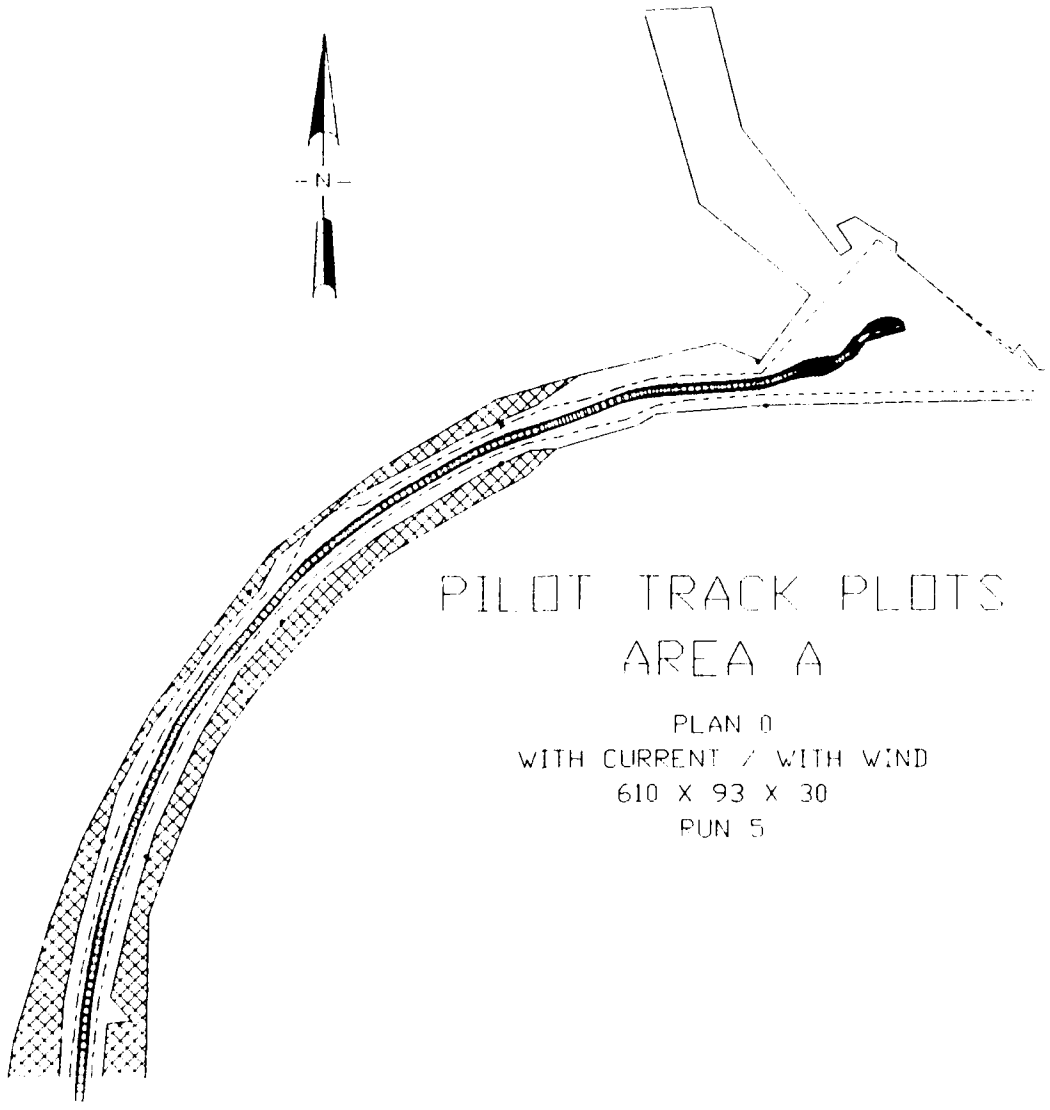
PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 3

PLATE B61

PLATE B62


PILOT TRACK PLOTS
AREA A
PLAN II
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 4

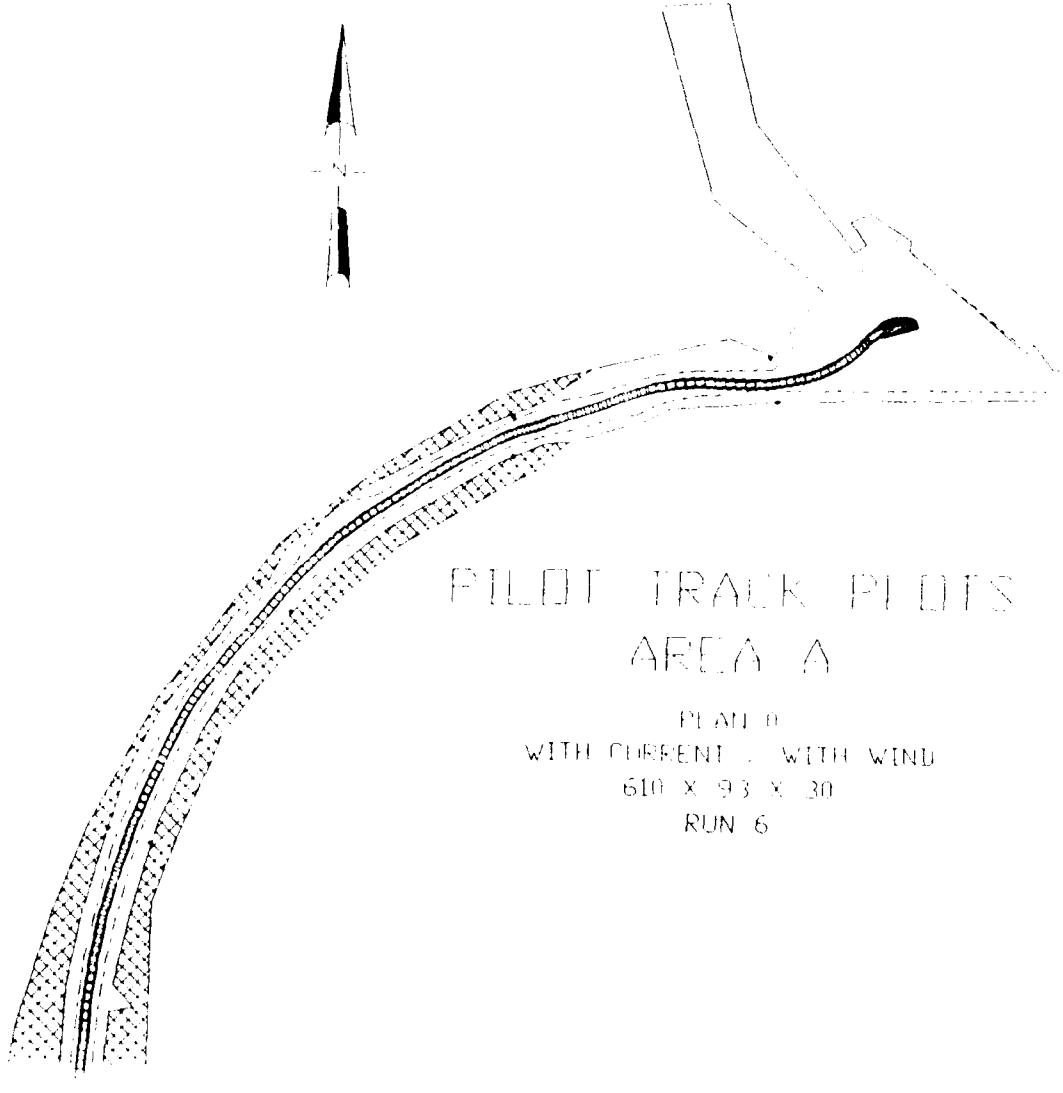


PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 5

PLATE B63

PLATE B64



PILOT TRACK PLOTS

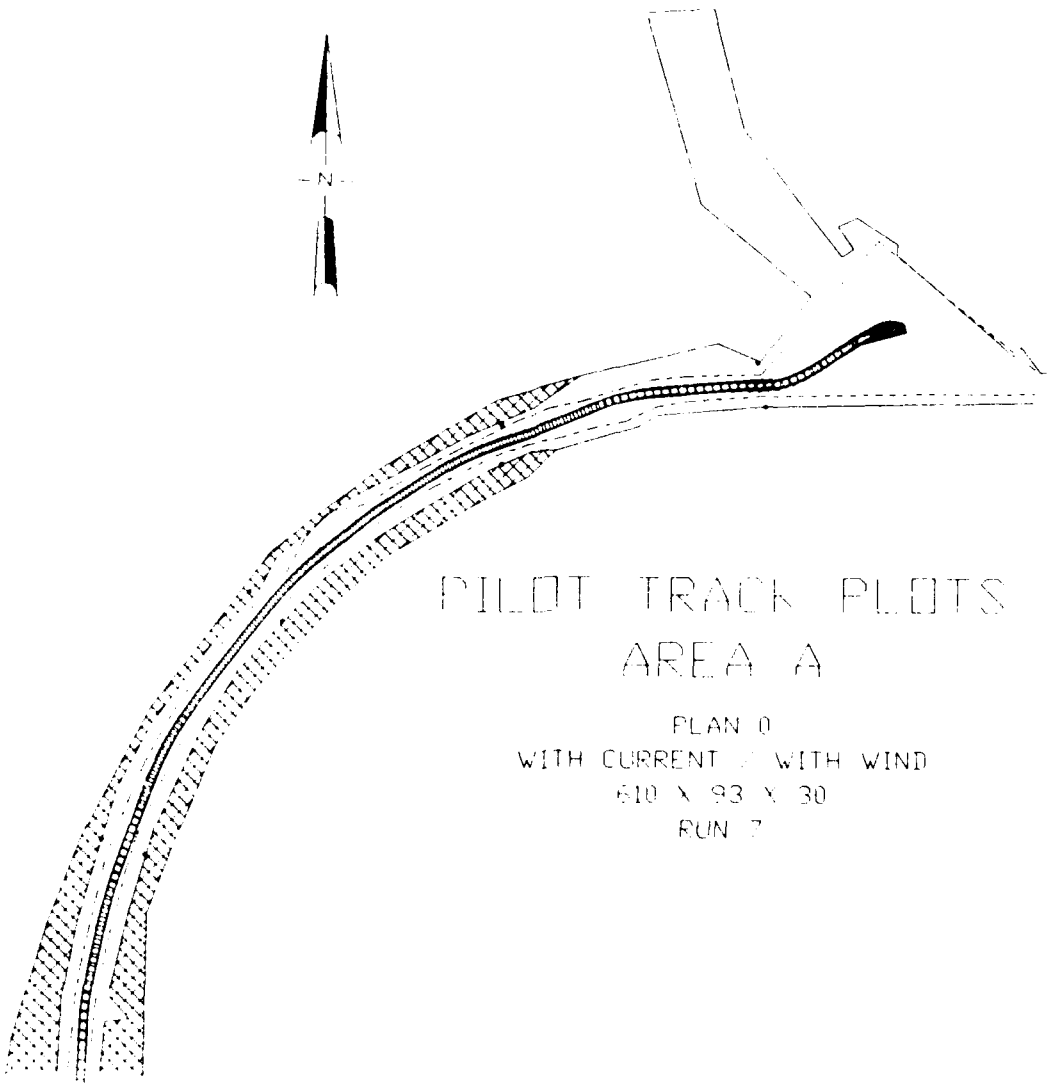
AREA A

PLAN 0

WITH CURRENT - WITH WIND

610 X 93 X 30

RUN 6



PILOT TRACK PLOTS

AREA A

PLAN 0

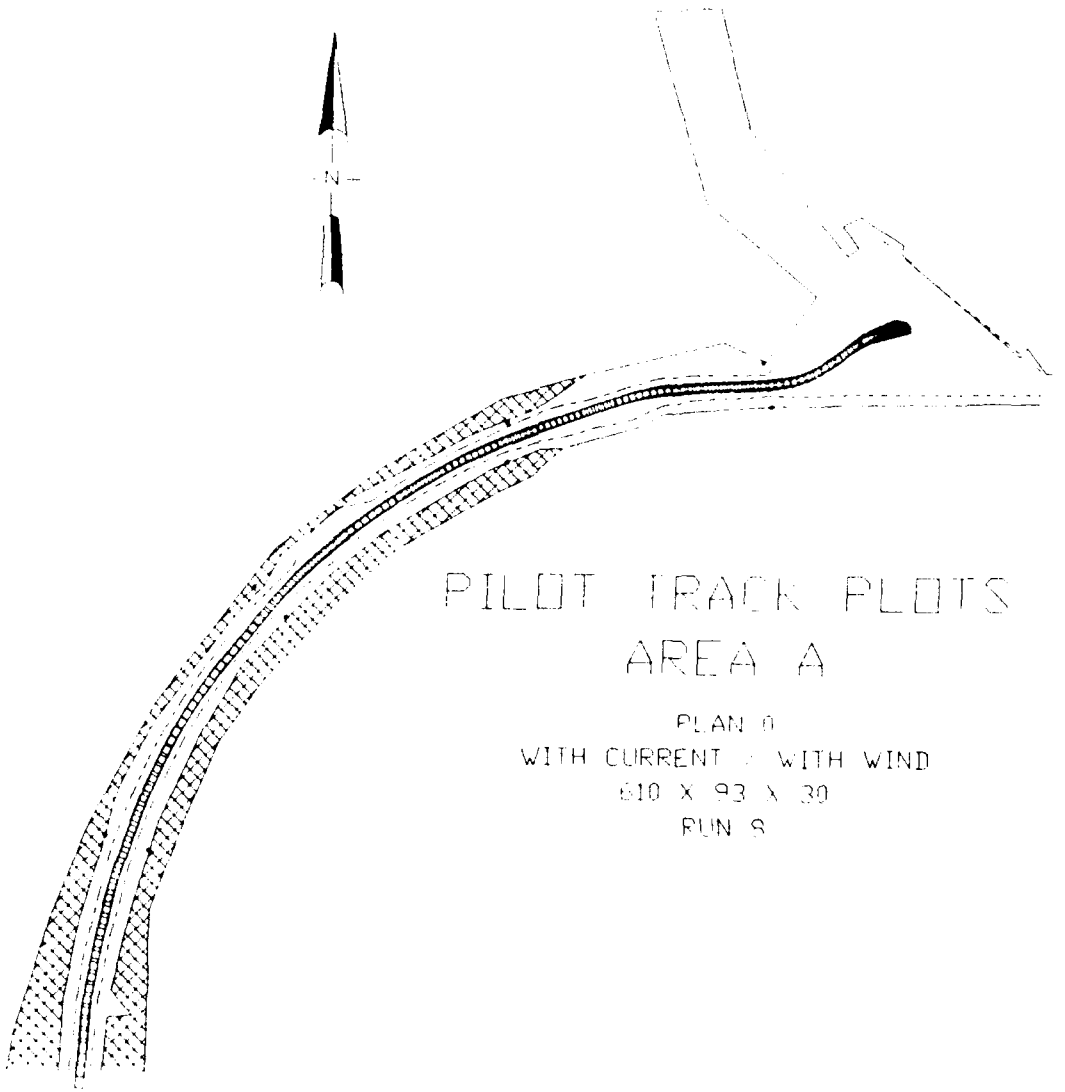
WITH CURRENT / WITH WIND

610 X 93 X 30

RUN 7

PLATE B65

PLATE B66



PILOT TRACK PLOTS

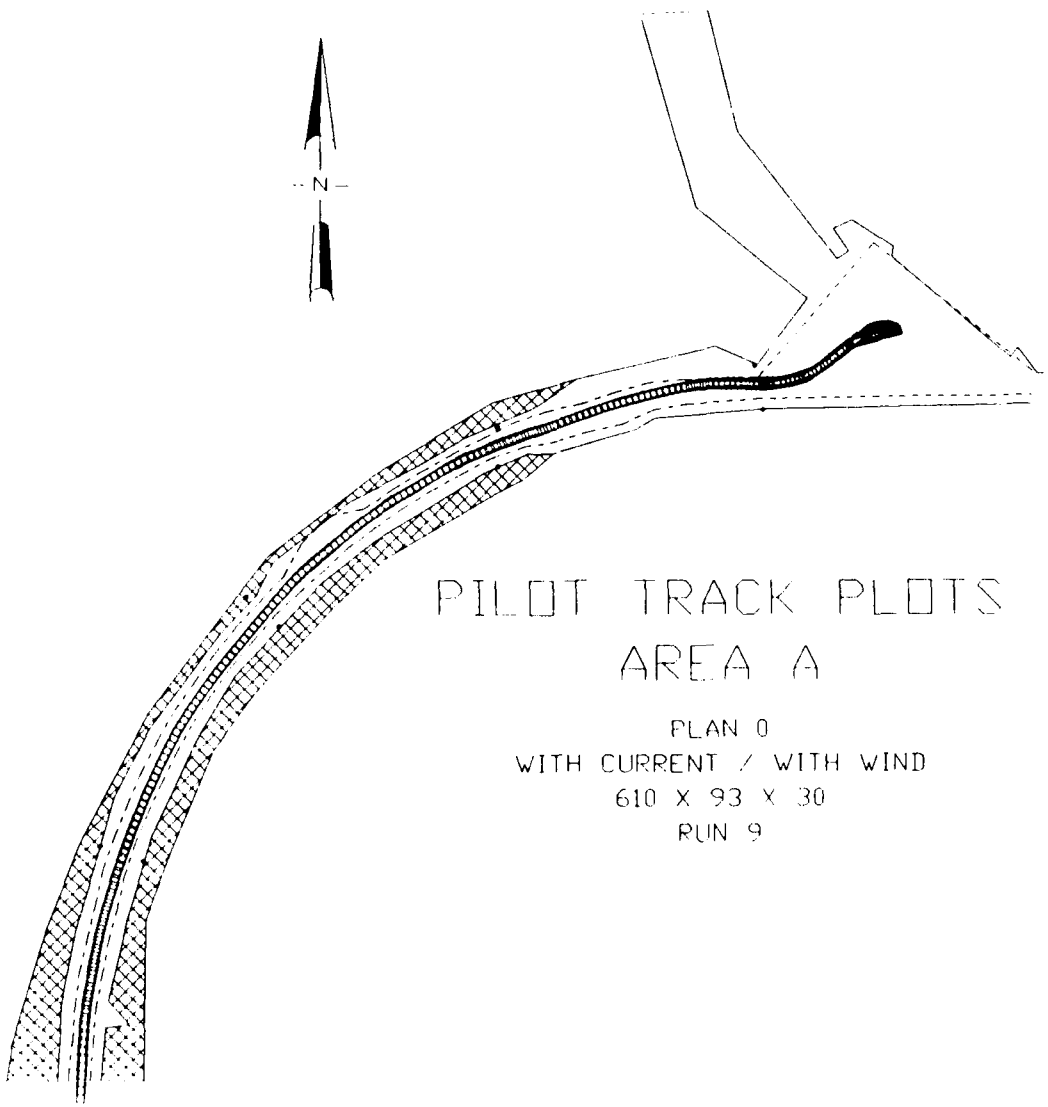
AREA A

PLAN 0

WITH CURRENT / WITH WIND

610 X 93 X 30

RUN 9

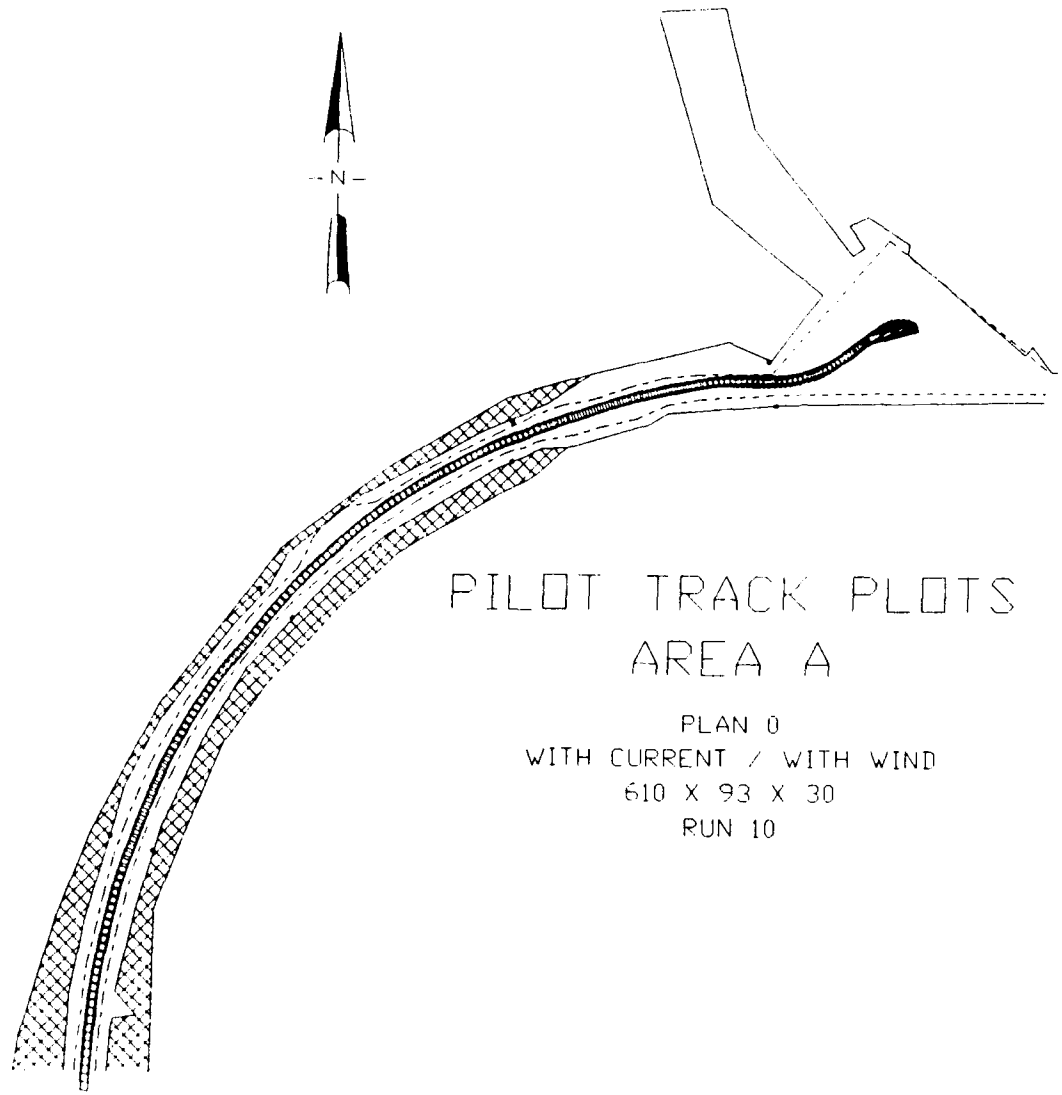


PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 9

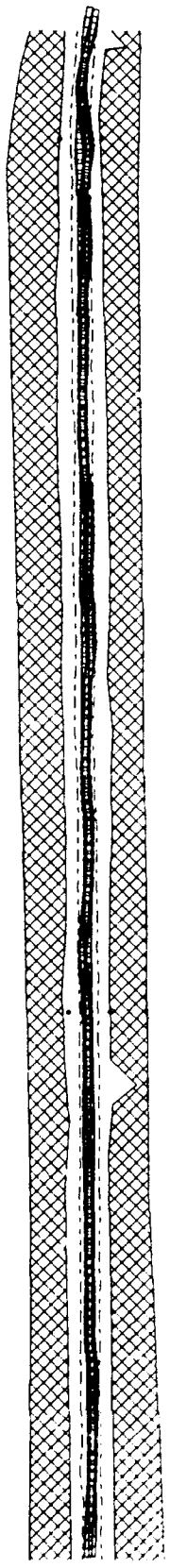
PLATE B67

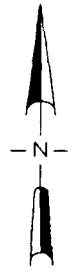
PLATE B68



PILOT TRACK PLOTS
AREA A

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 10

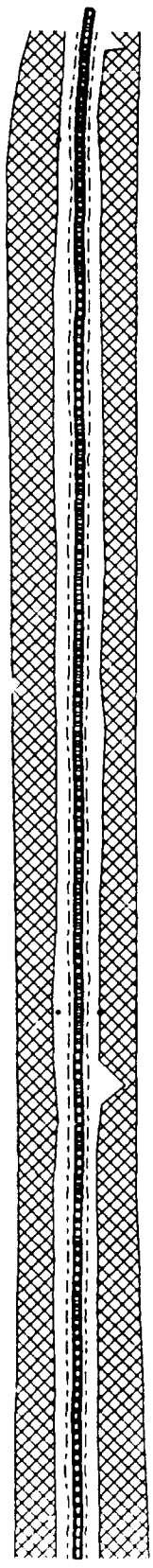


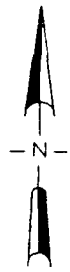


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 1

PLATE B69

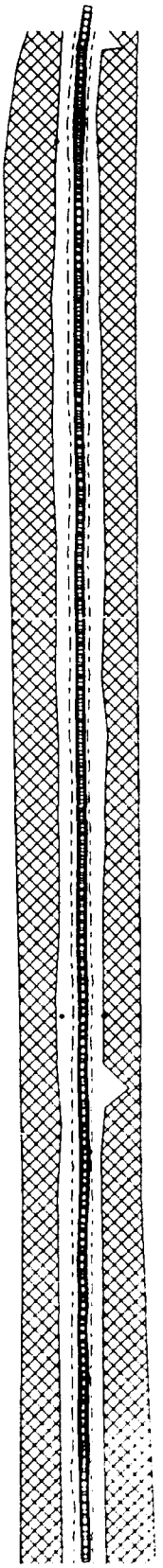


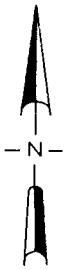


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 2

PLATE B70

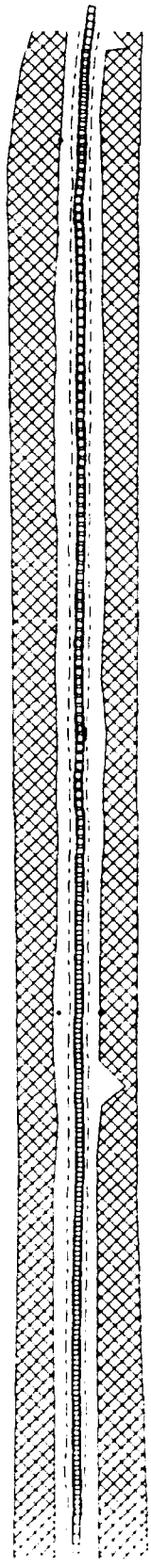


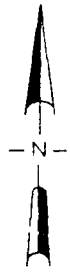


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 3

PLATE B71

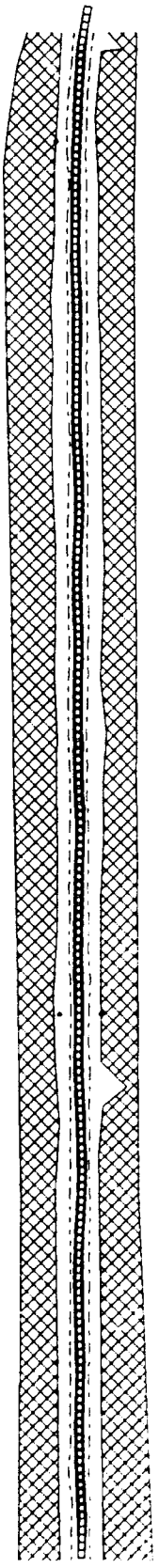


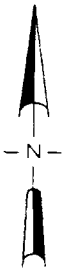


PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 4

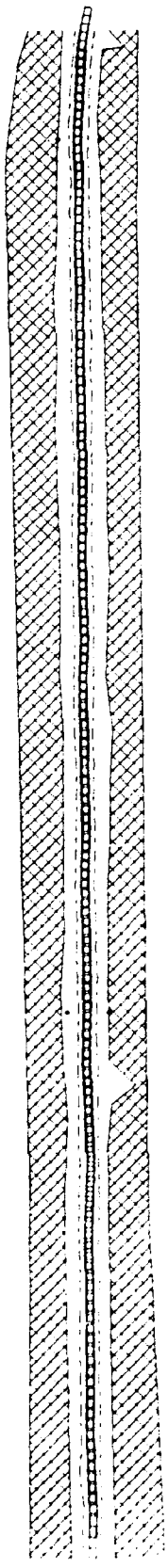
PLATE B72

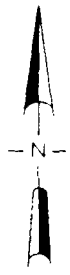




PILOT TRACK PLOTS
AREA B

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 5



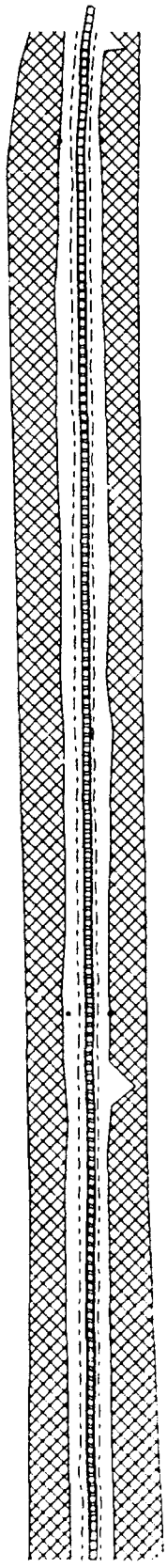


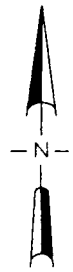
PILOT TRACK PLOTS

AREA B

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 6

PLATE B74



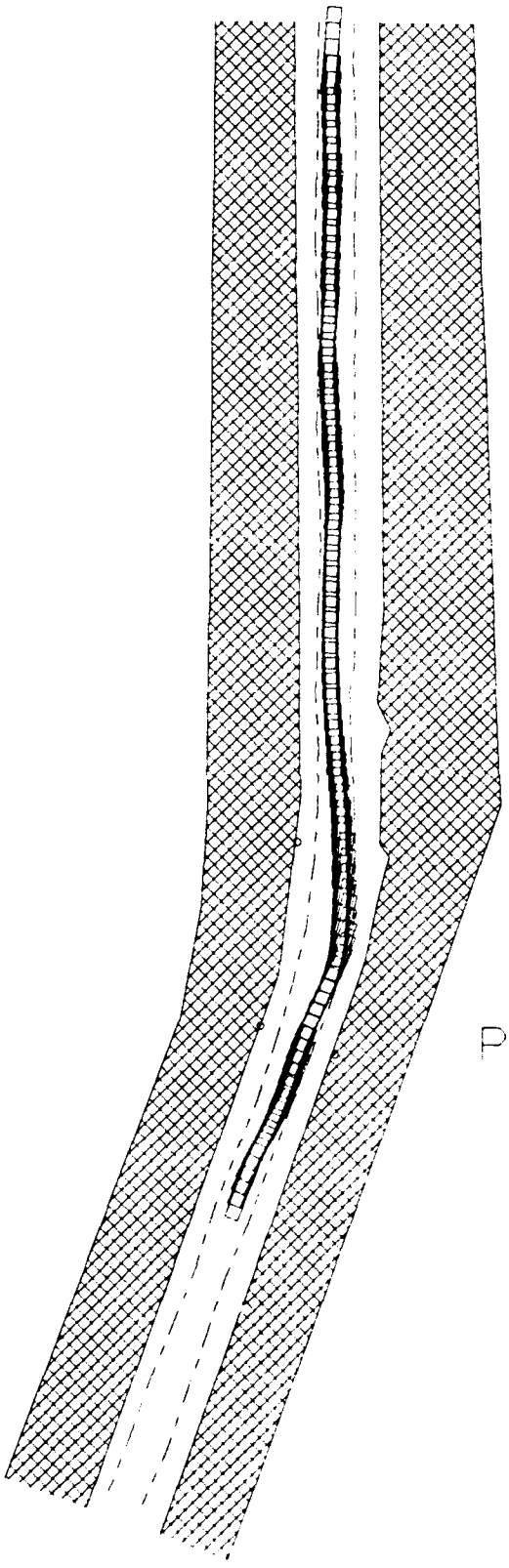


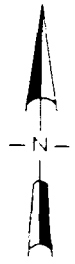
PILOT TRACK PLOTS

AREA B

PLAN 0
WITH CURPENT / WITH WIND
610 X 93 X 30
RUN 7

PLATE B75

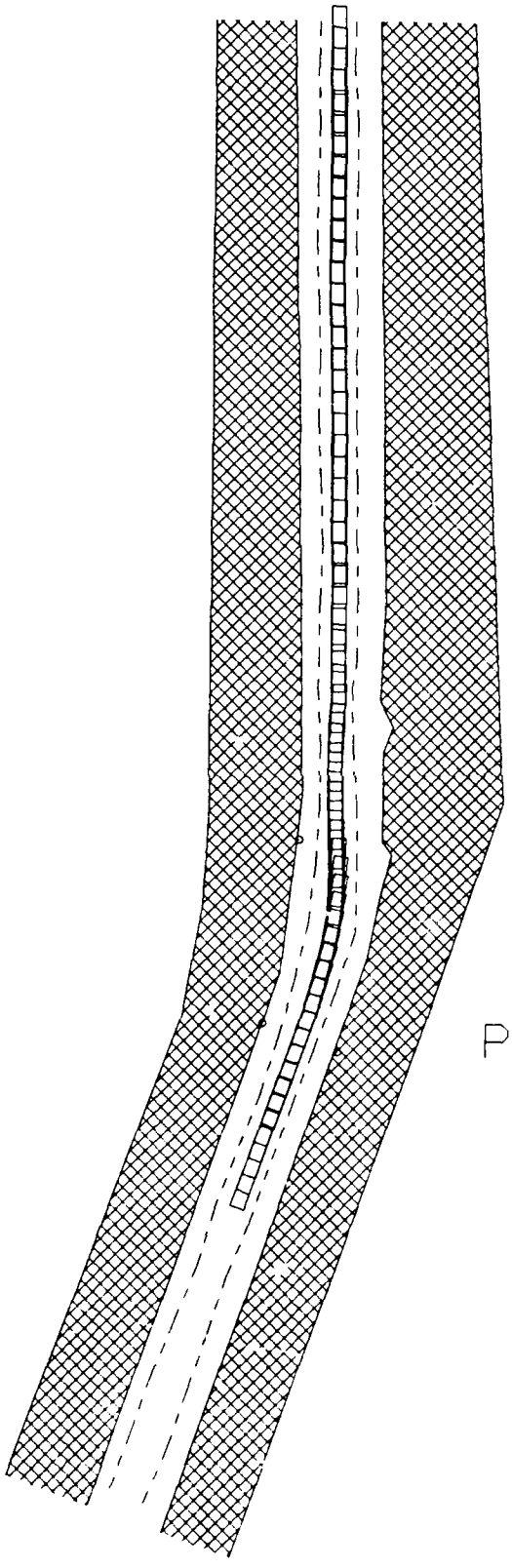


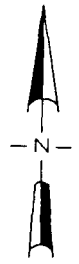


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / WITH WIND
610 x 93 x 30
RUN 1

PLATE B76

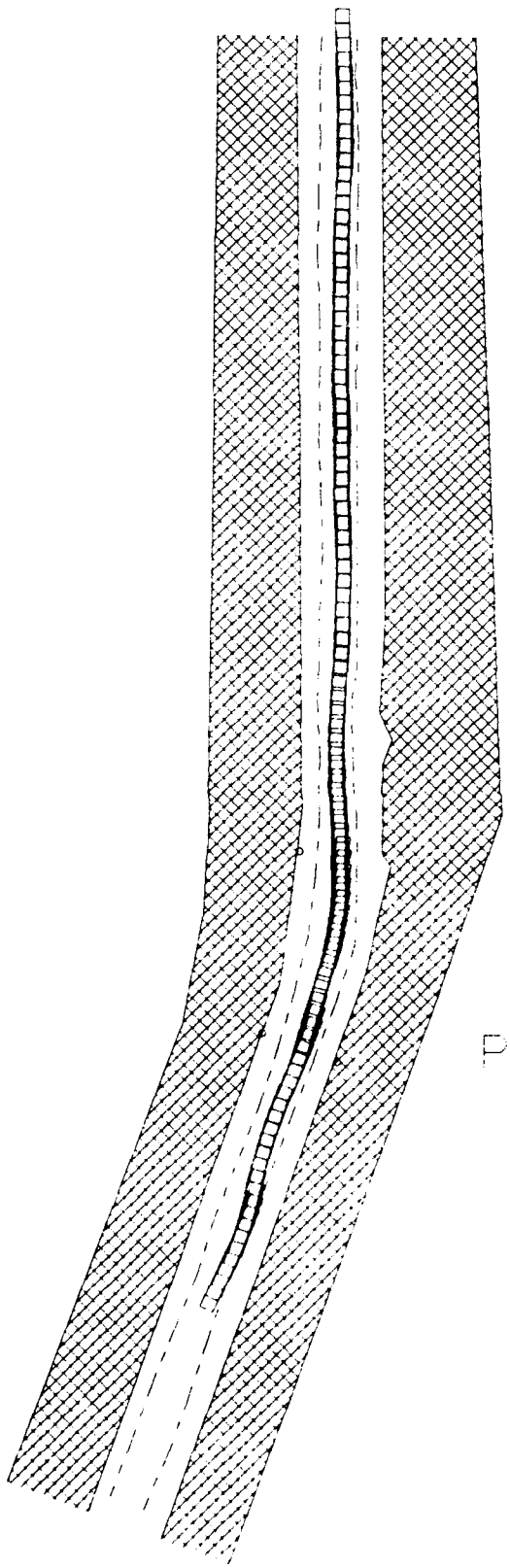


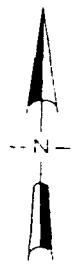


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 2

PLATE B77

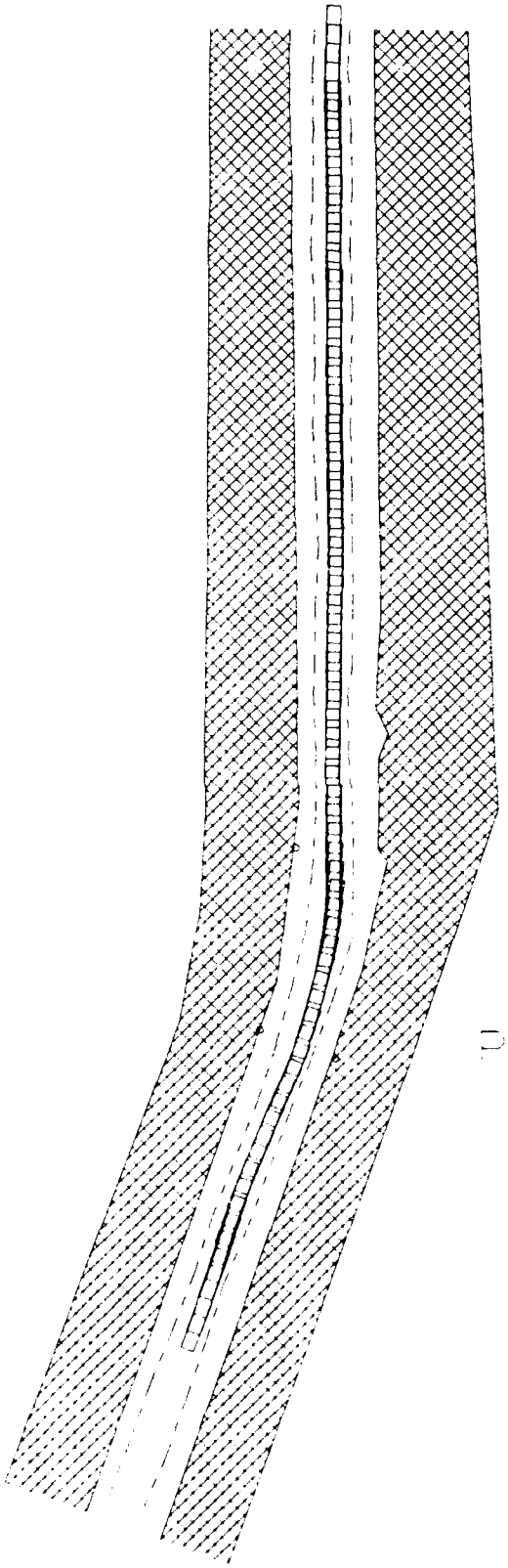


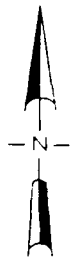


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 3

PLATE B78





PILOT TRACK PLOTS
AREA C

PLAN 8
WITH CURRENT / WITH WIND
610 X 92 X 30
RUN 4

PLATE B79

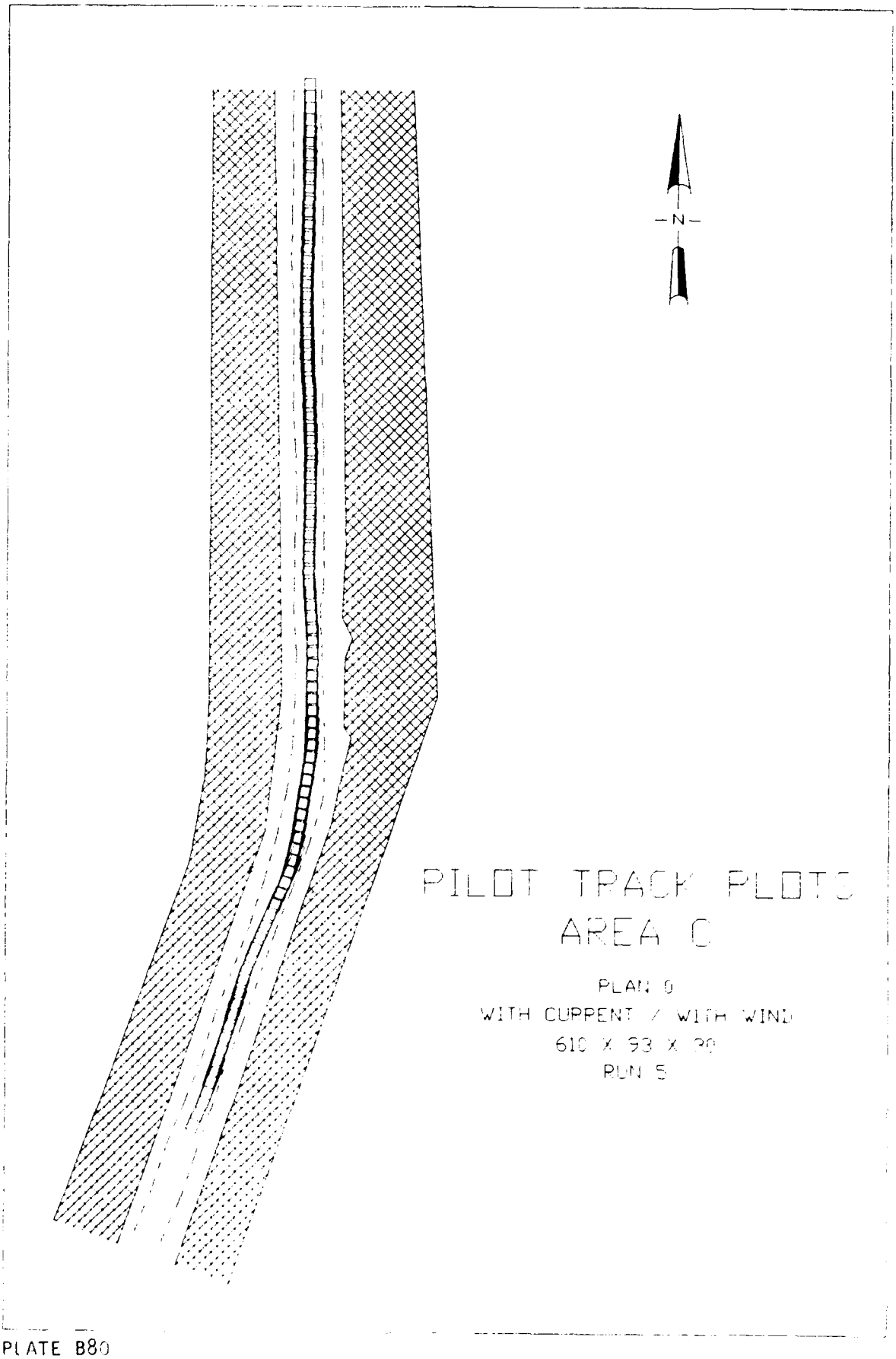
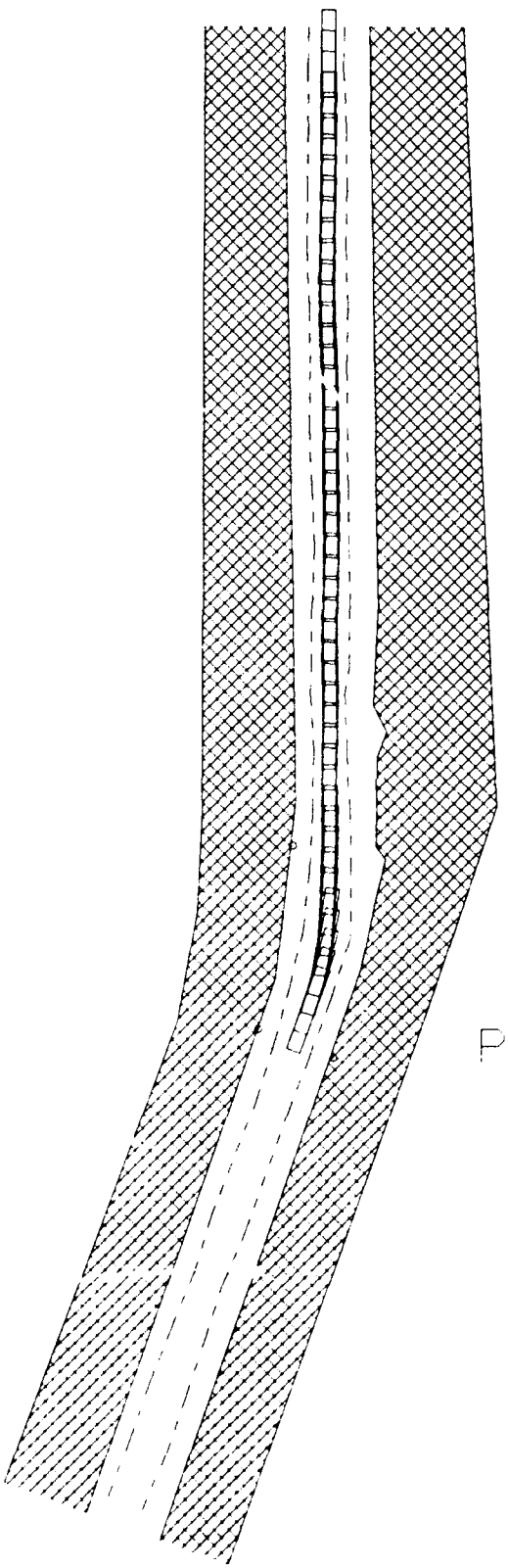
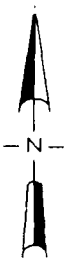

N
PILOT TRACK PLOTS
AREA C
PLAN 9
WITH CURRENT / WITH WIND
610 X 93 X 20
RUN 5

PLATE B80

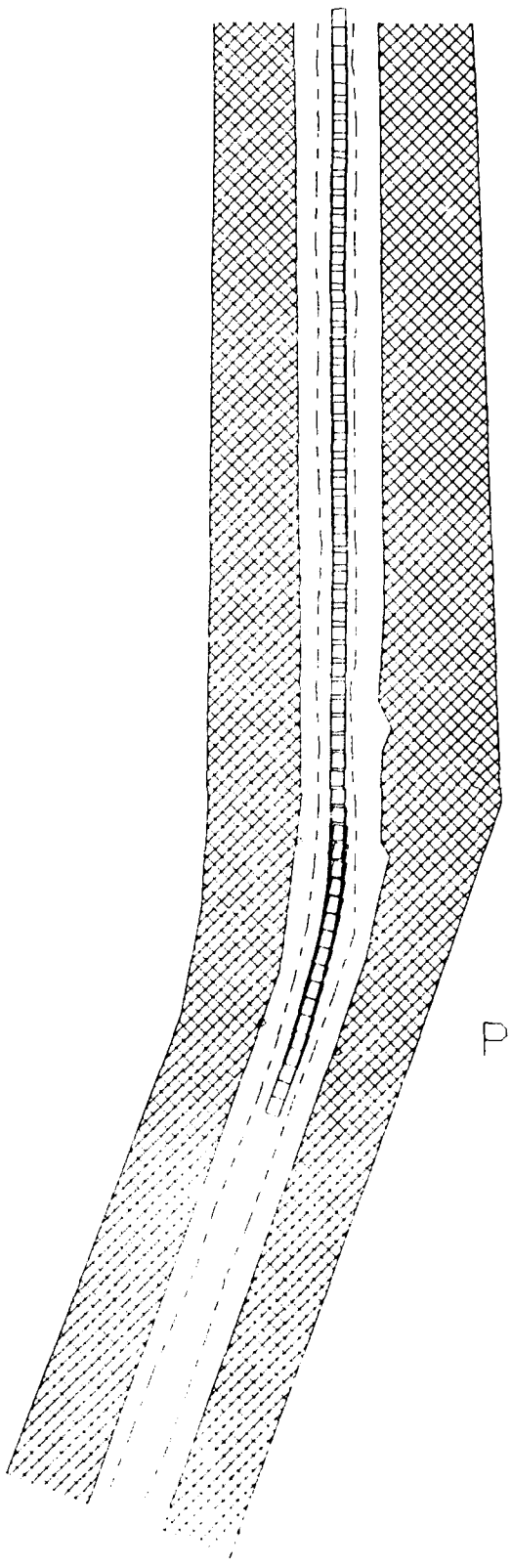


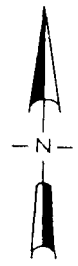


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 6

PLATE B81

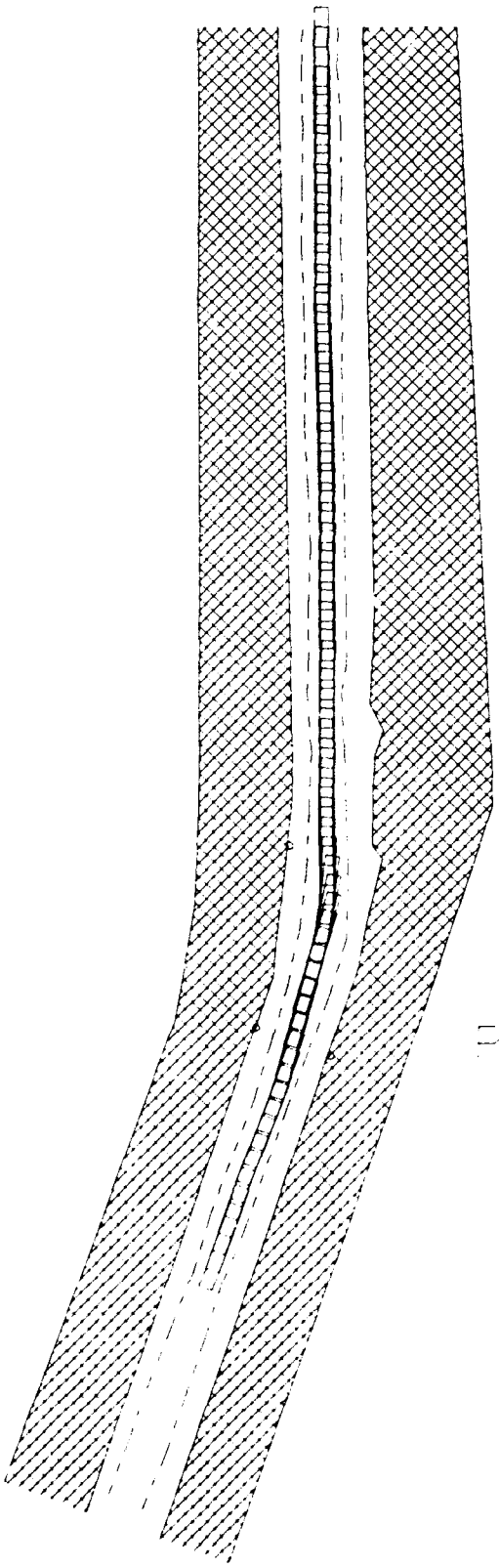


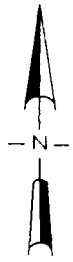


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / WITH WIND
610 X 93 X 30
RUN 7

PLATE B82

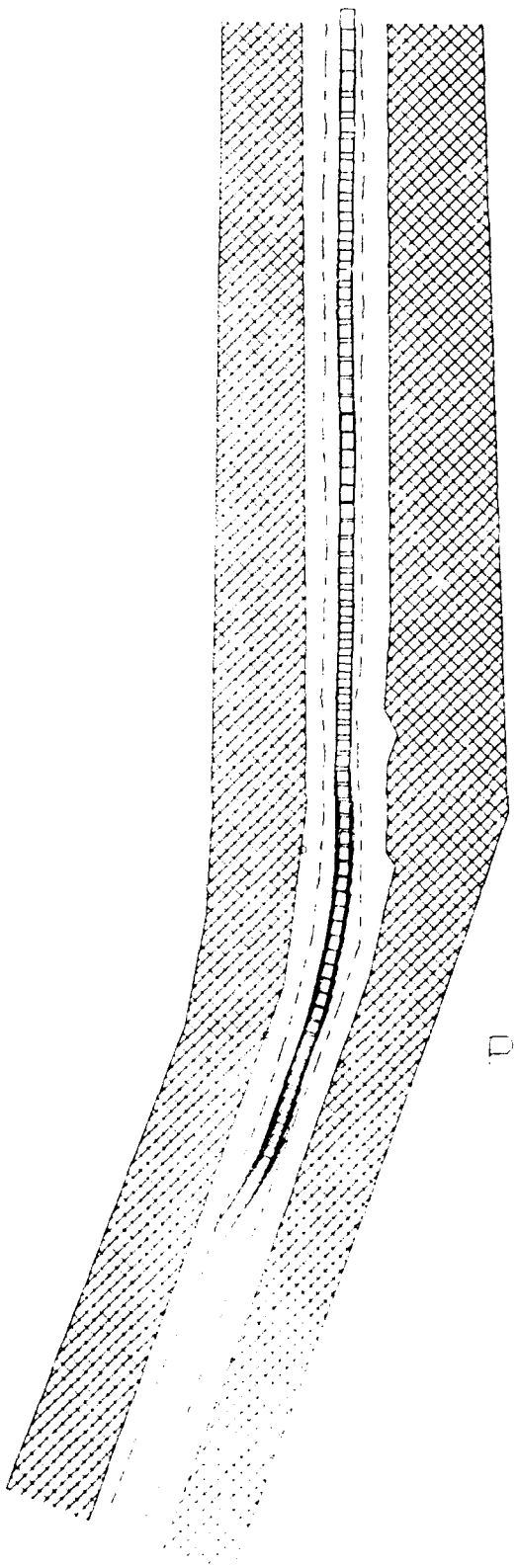


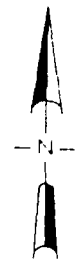


PILOT TRACK PLOT
AREA C

PLAN 9
WITH CURRENT / WITH WIND
610 x 93 x 30
RUN 8

PLATE B83

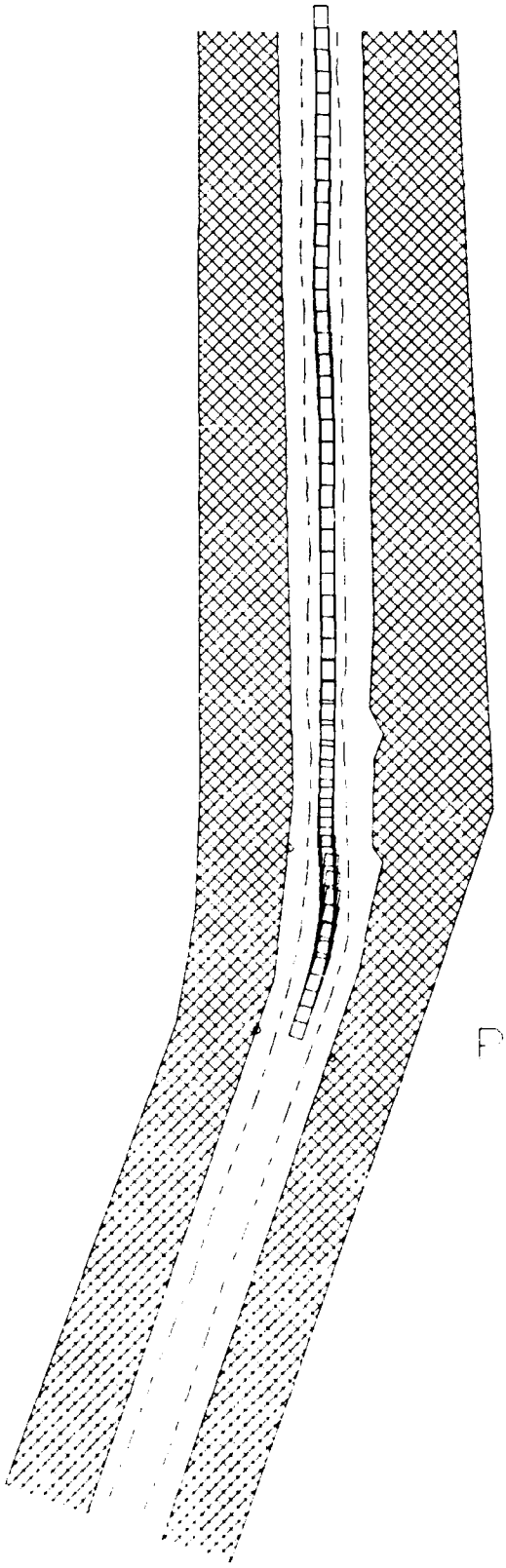


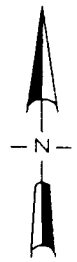


PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURRENT / WITH WIND
610 x 93 x 30
RUN 9

PLATE B84





PILOT TRACK PLOTS
AREA C

PLAN 0
WITH CURPENT / WITH WIND
610 x 93 X 30
RUN 10

PLATE B85

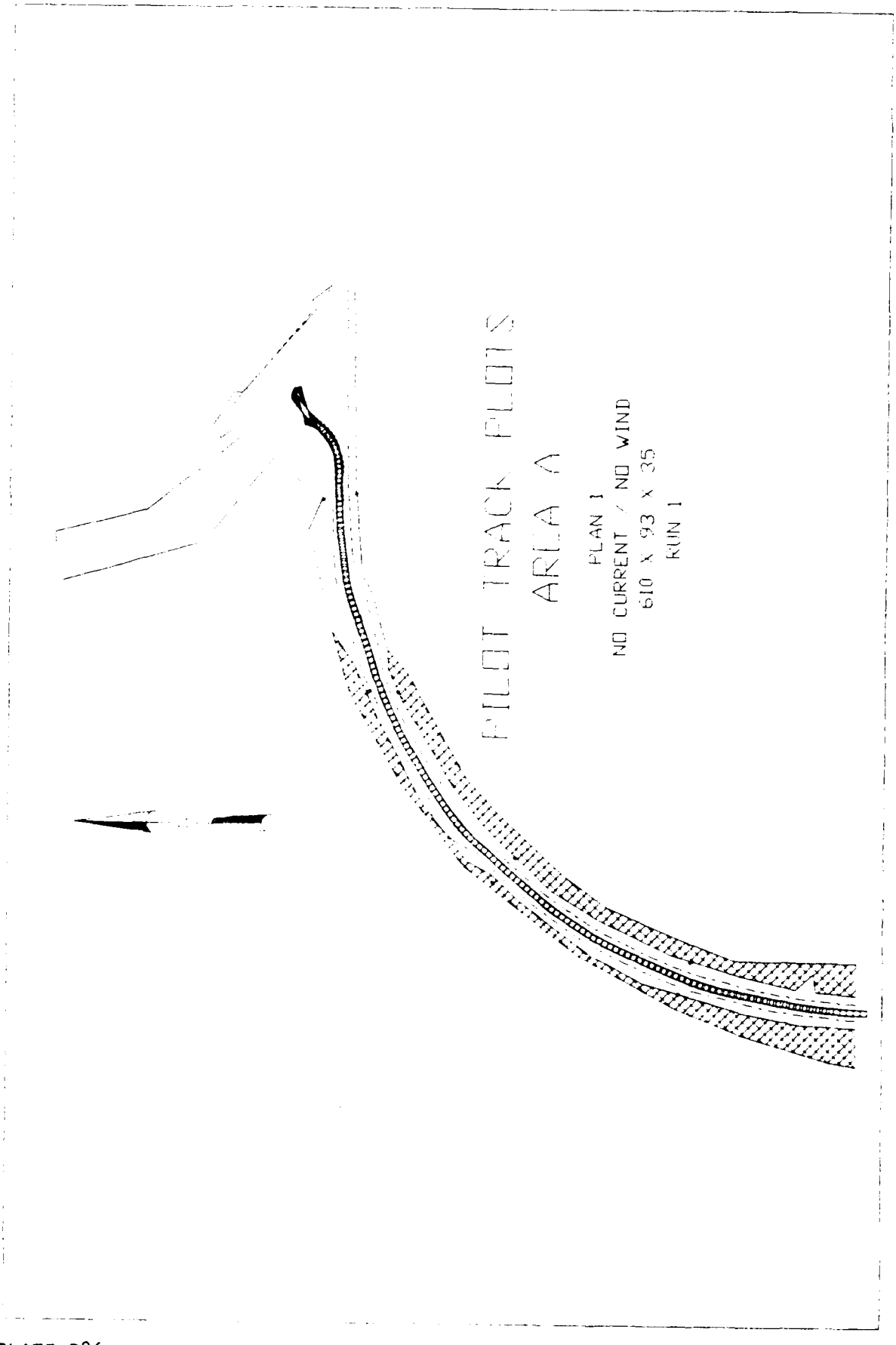
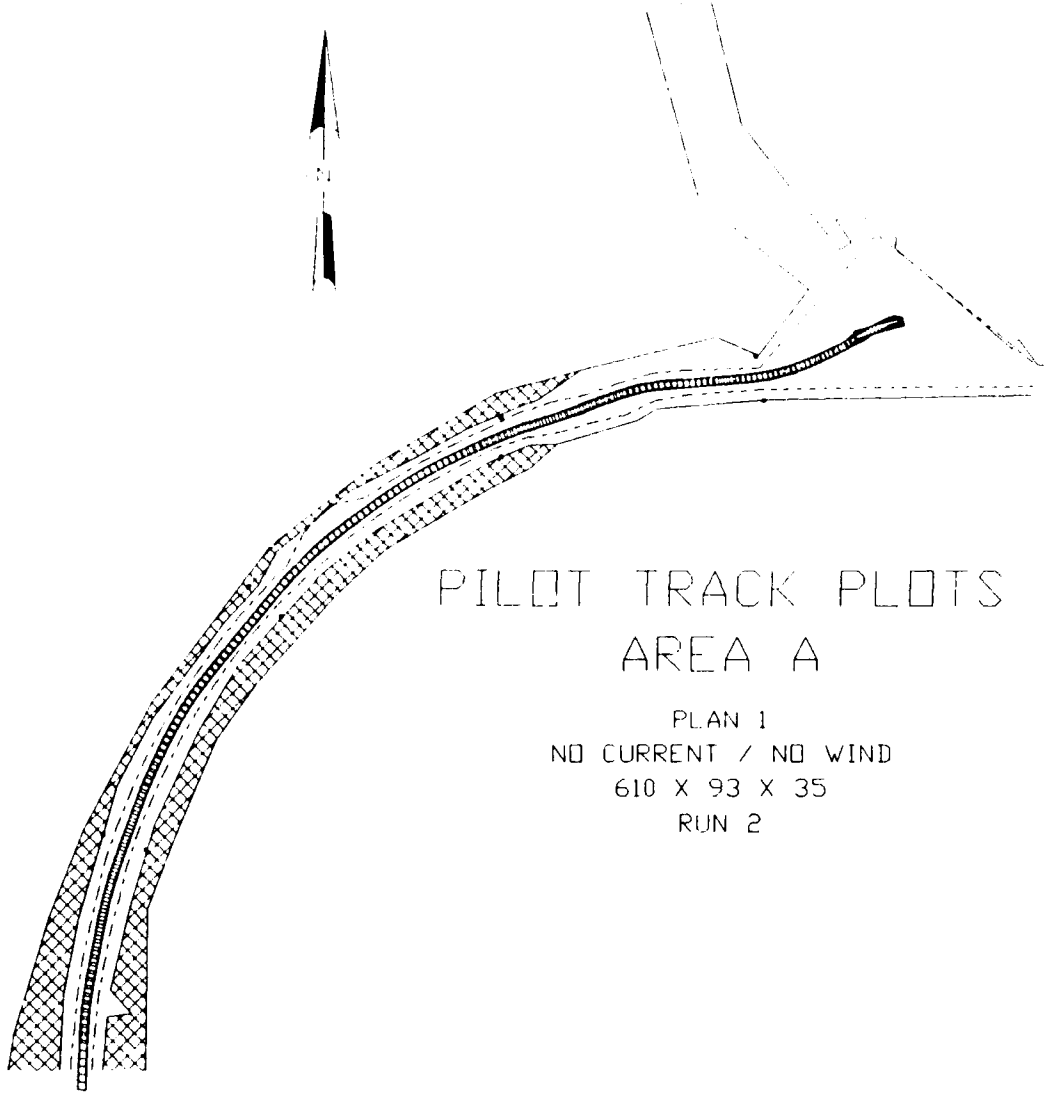

PILOT TRACK PLOTS
ARLA A
PLAN 1
NO CURRENT / NO WIND
610 x 93 x 35
RUN 1

PLATE B86

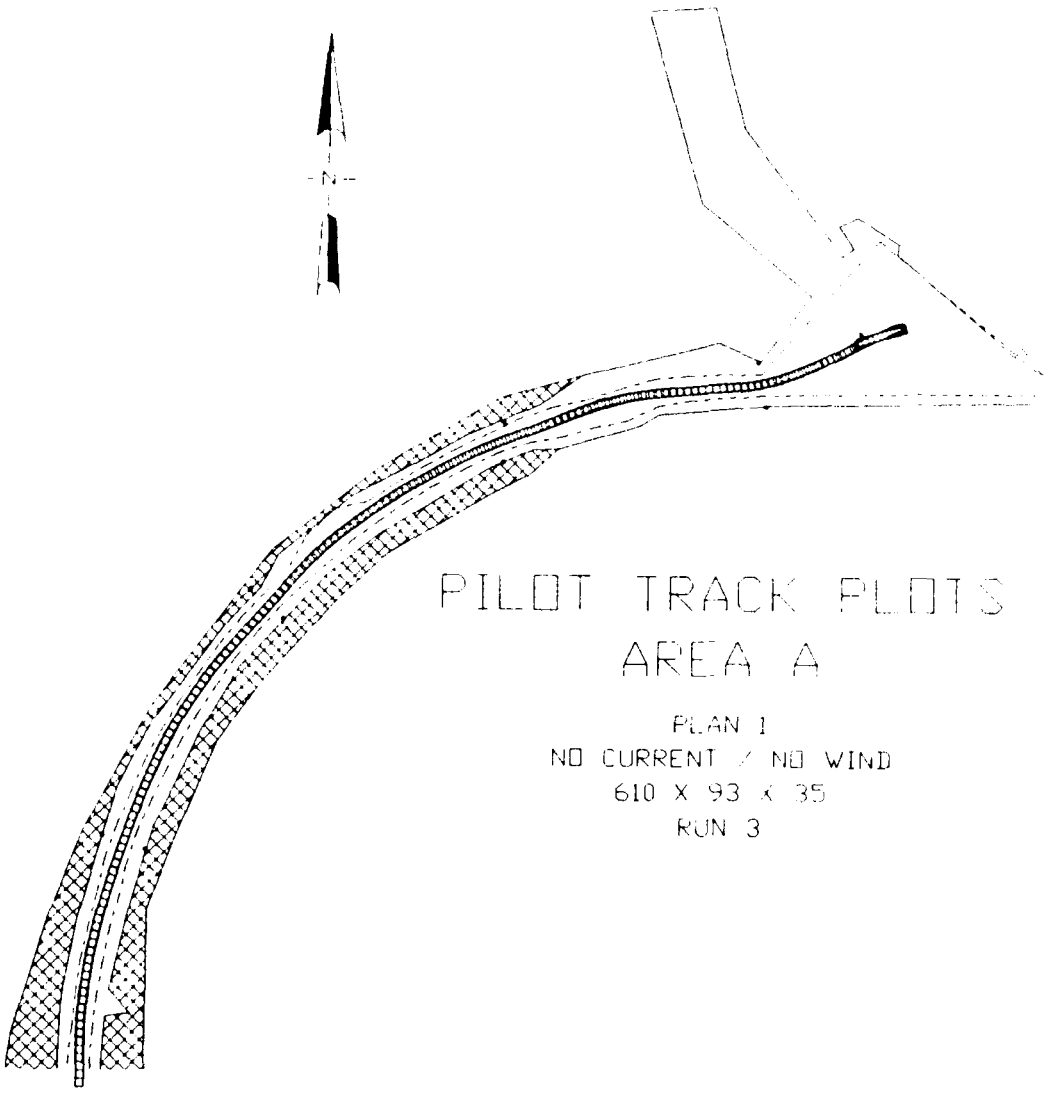


PILOT TRACK PLOTS
AREA A

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 2

PLATE B87

PLATE B88



PILOT TRACK PLOTS
AREA A

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 3

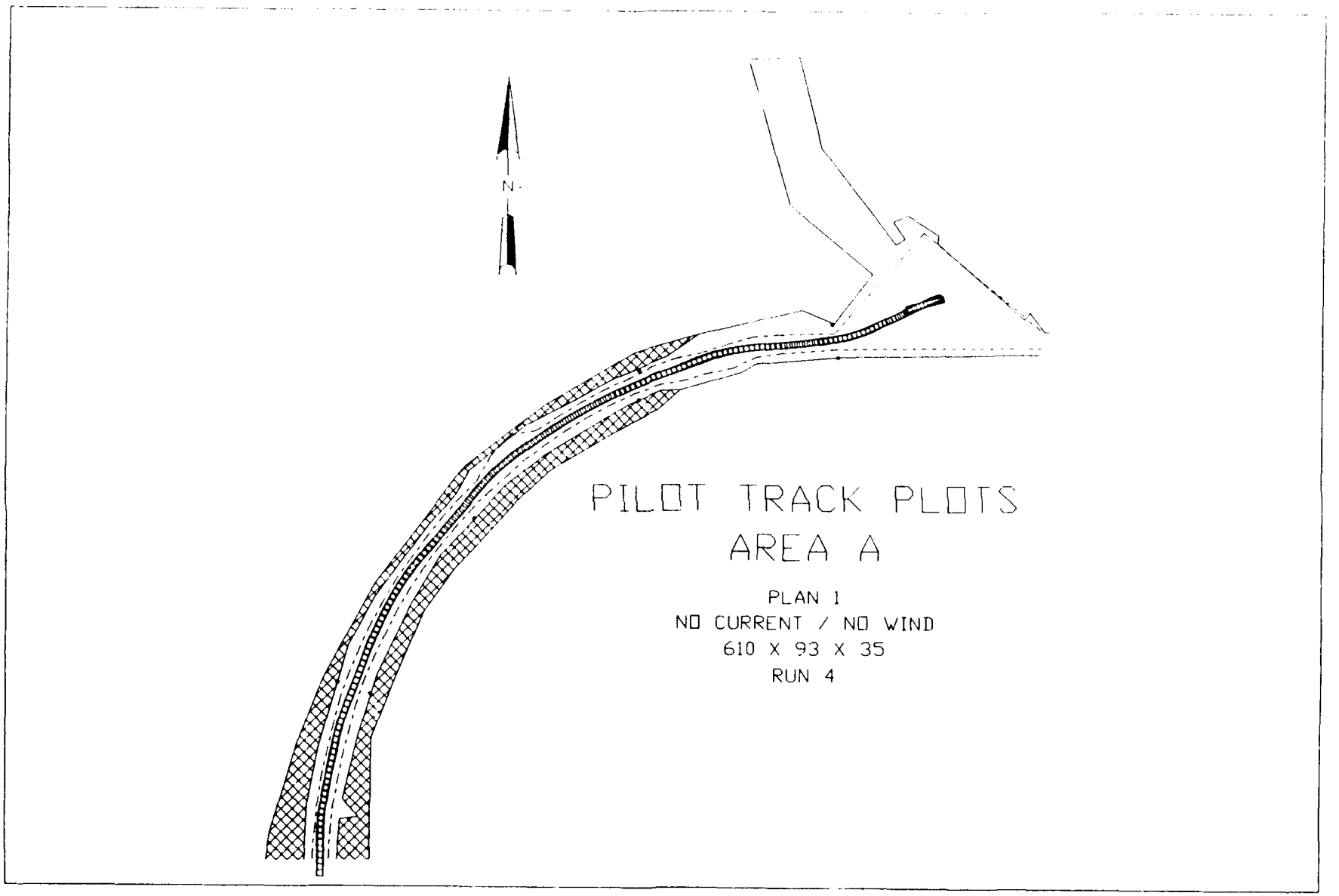

N
PILOT TRACK PLOTS
AREA A
PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 4

PLATE B89

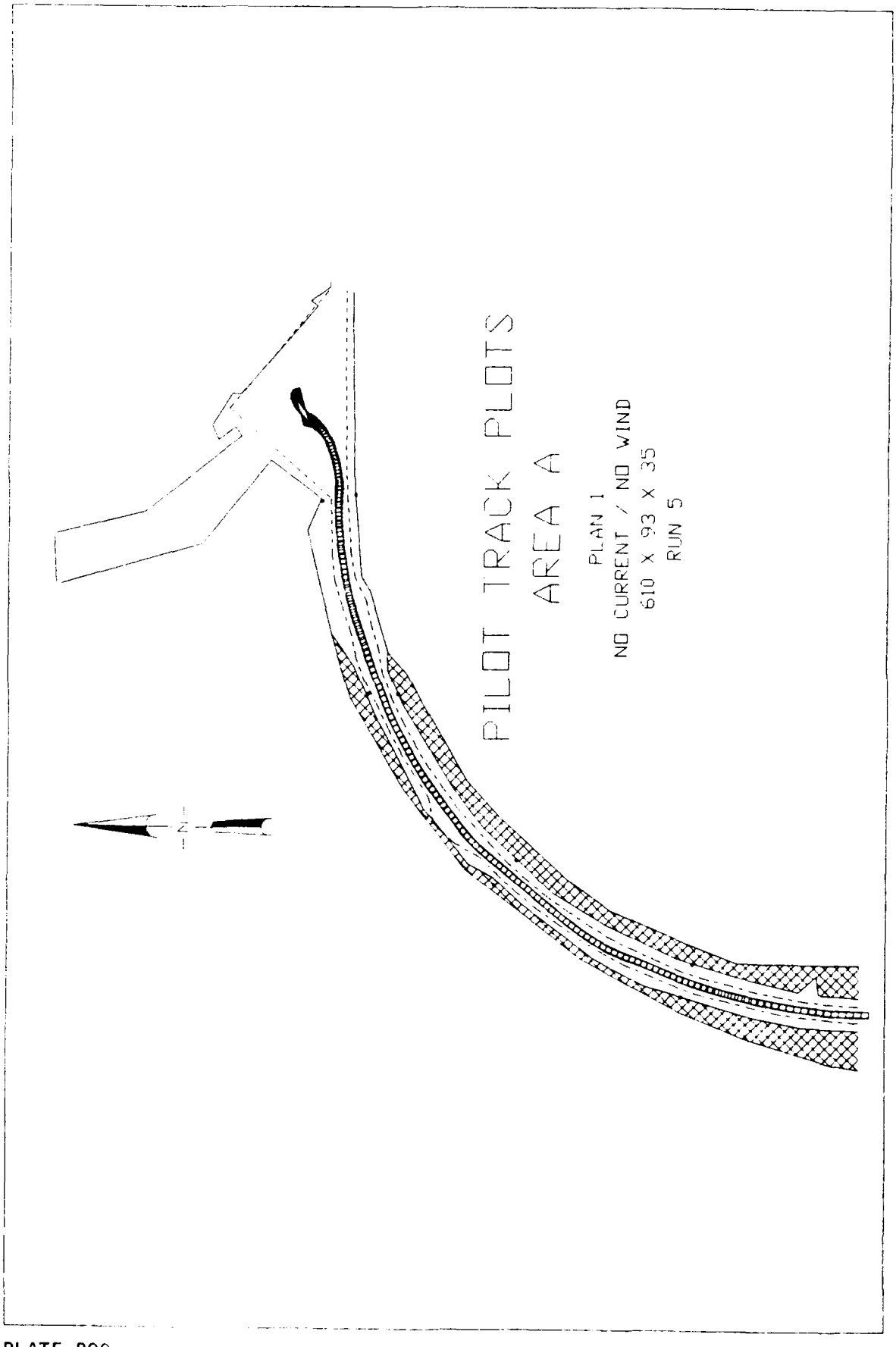
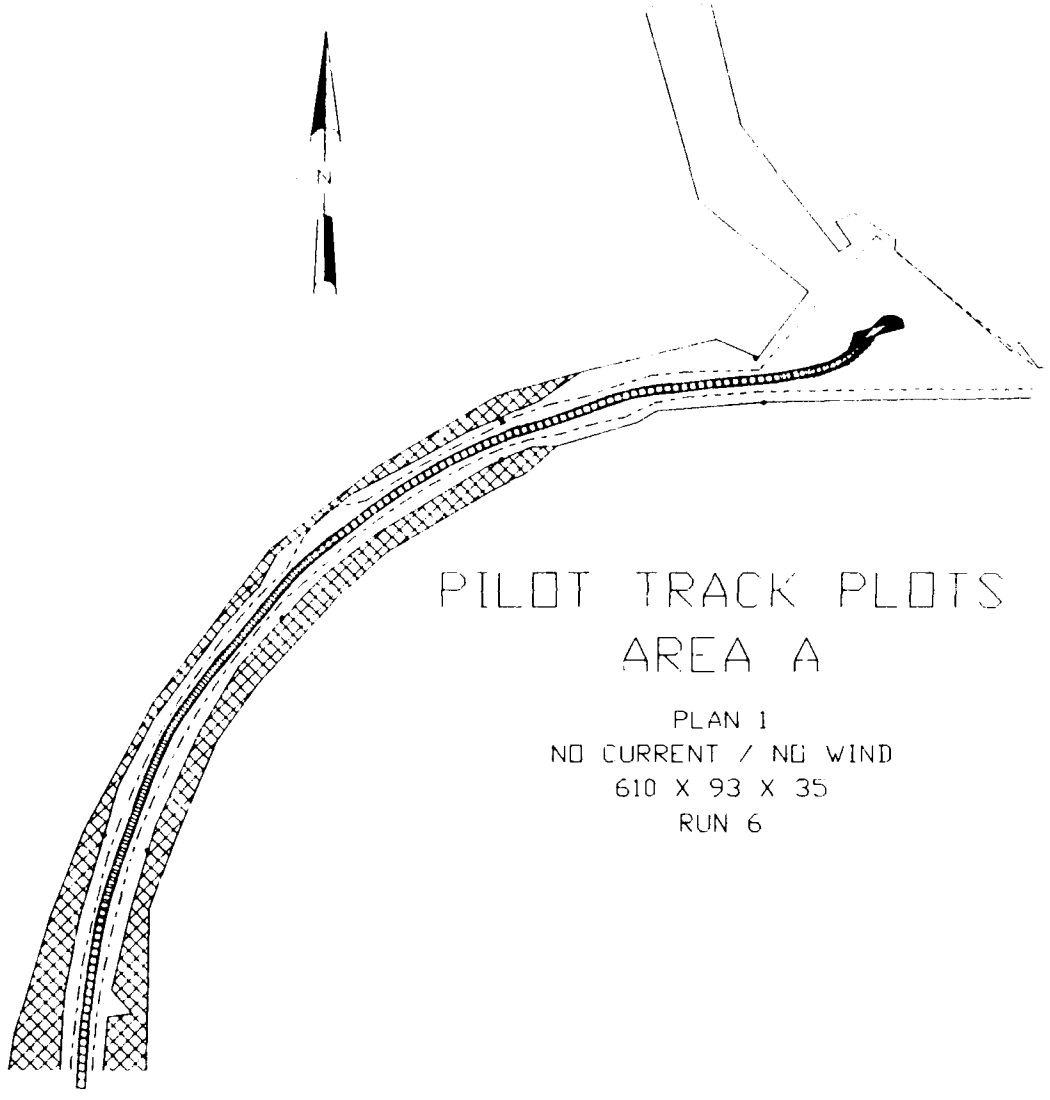

PILOT TRACK PLOTS
AREA A
PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 5

PLATE B90



PILOT TRACK PLOTS
AREA A

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 6

PLATE B91

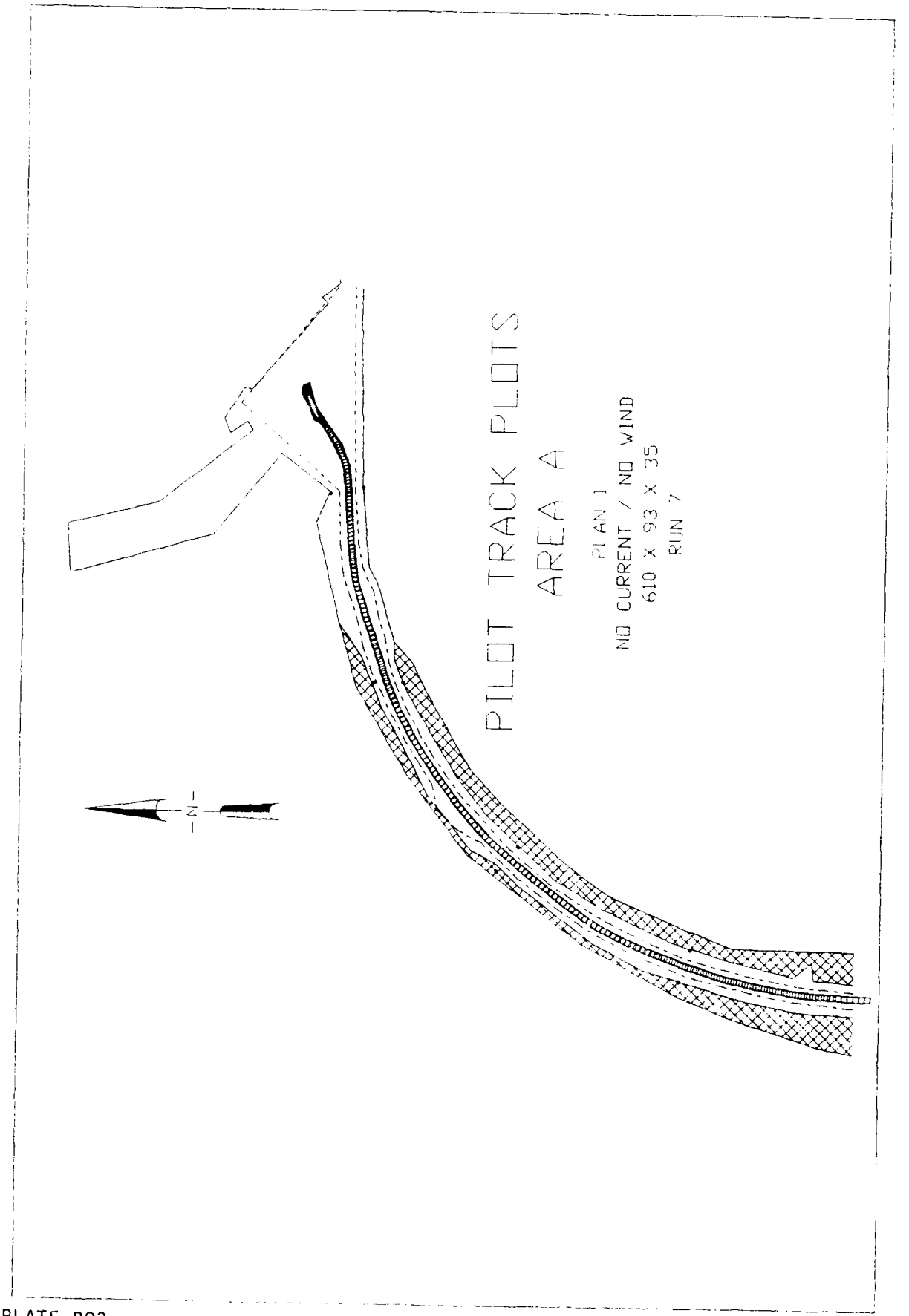
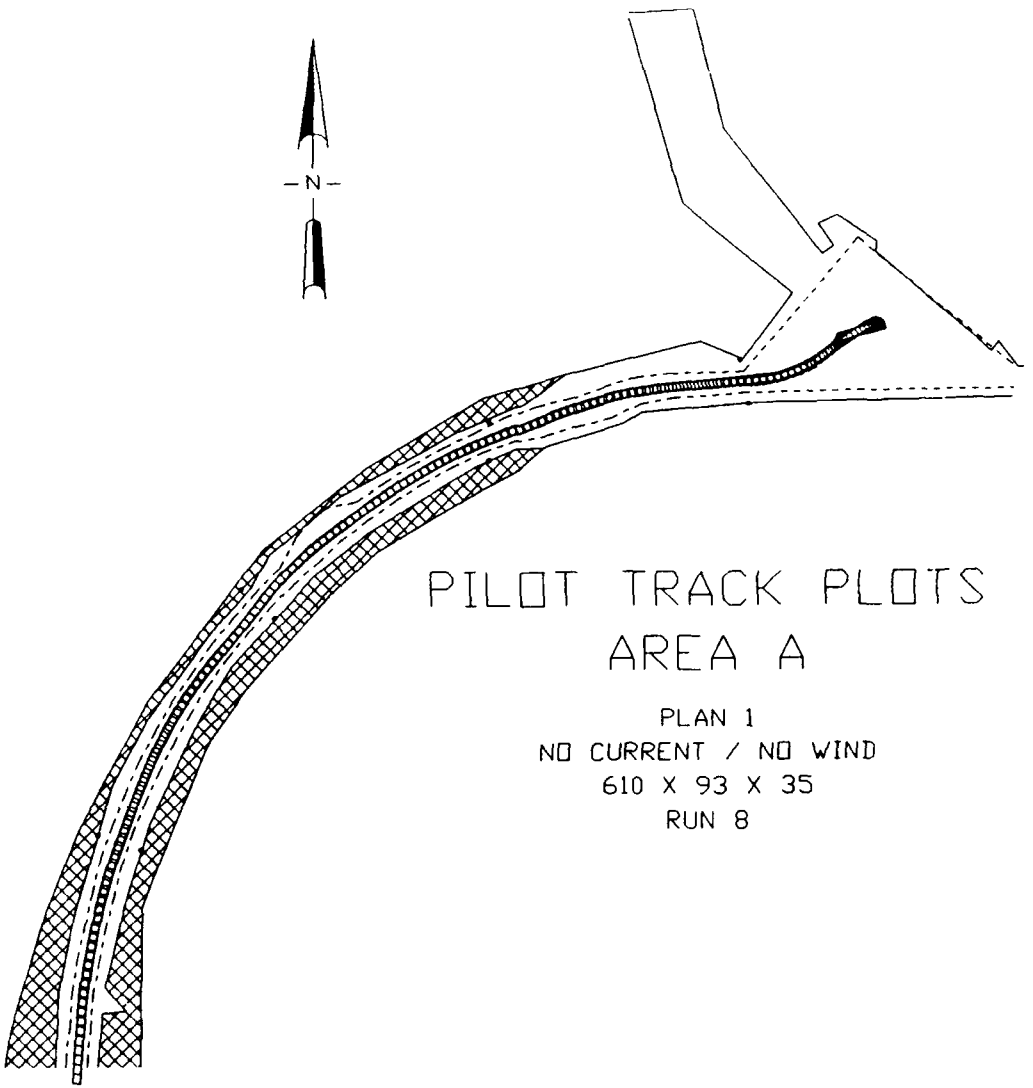

PILOT TRACK PLOTS
AREA A
PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 7
N

PLATE B92



PILOT TRACK PLOTS
AREA A

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 8

PLATE B93

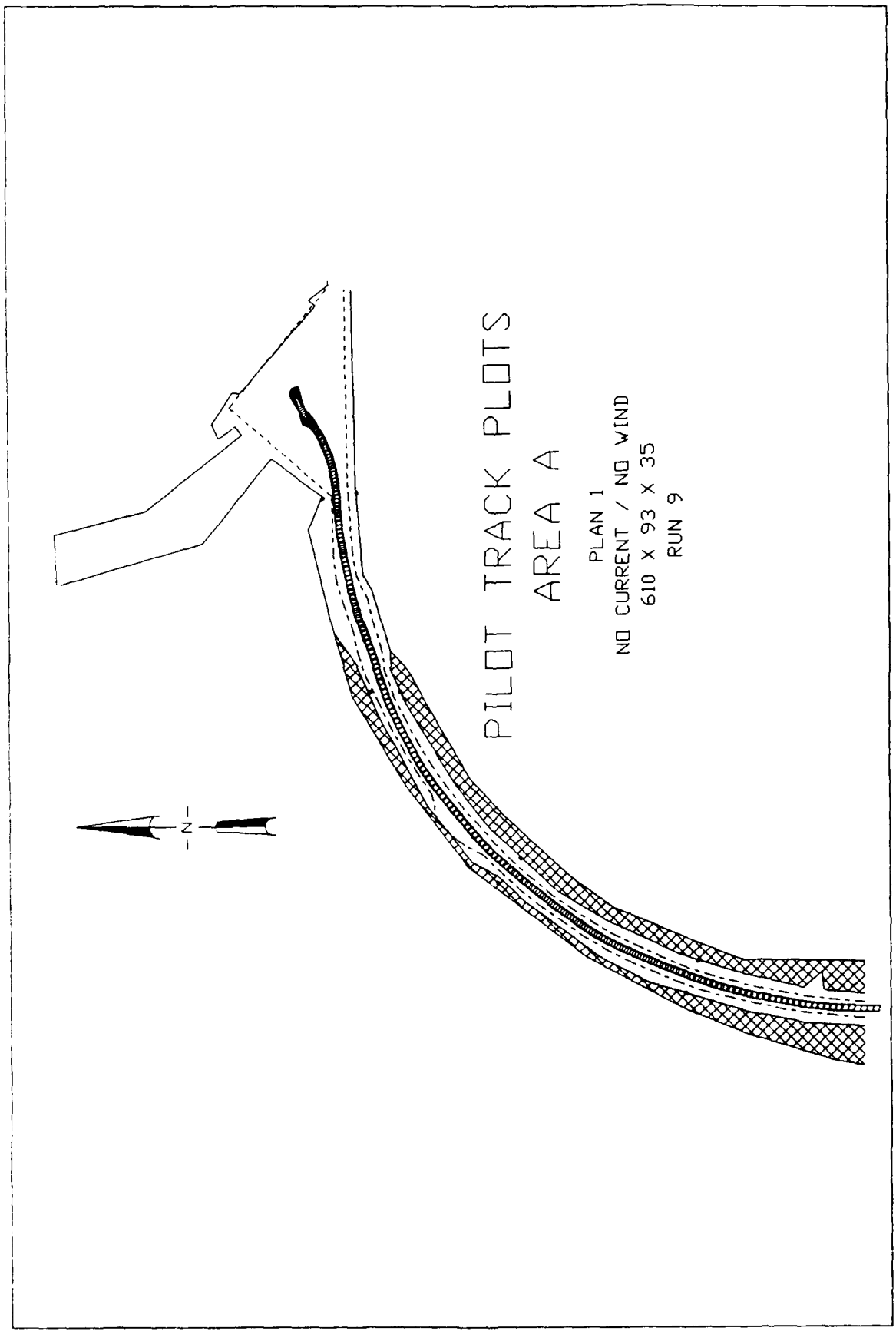
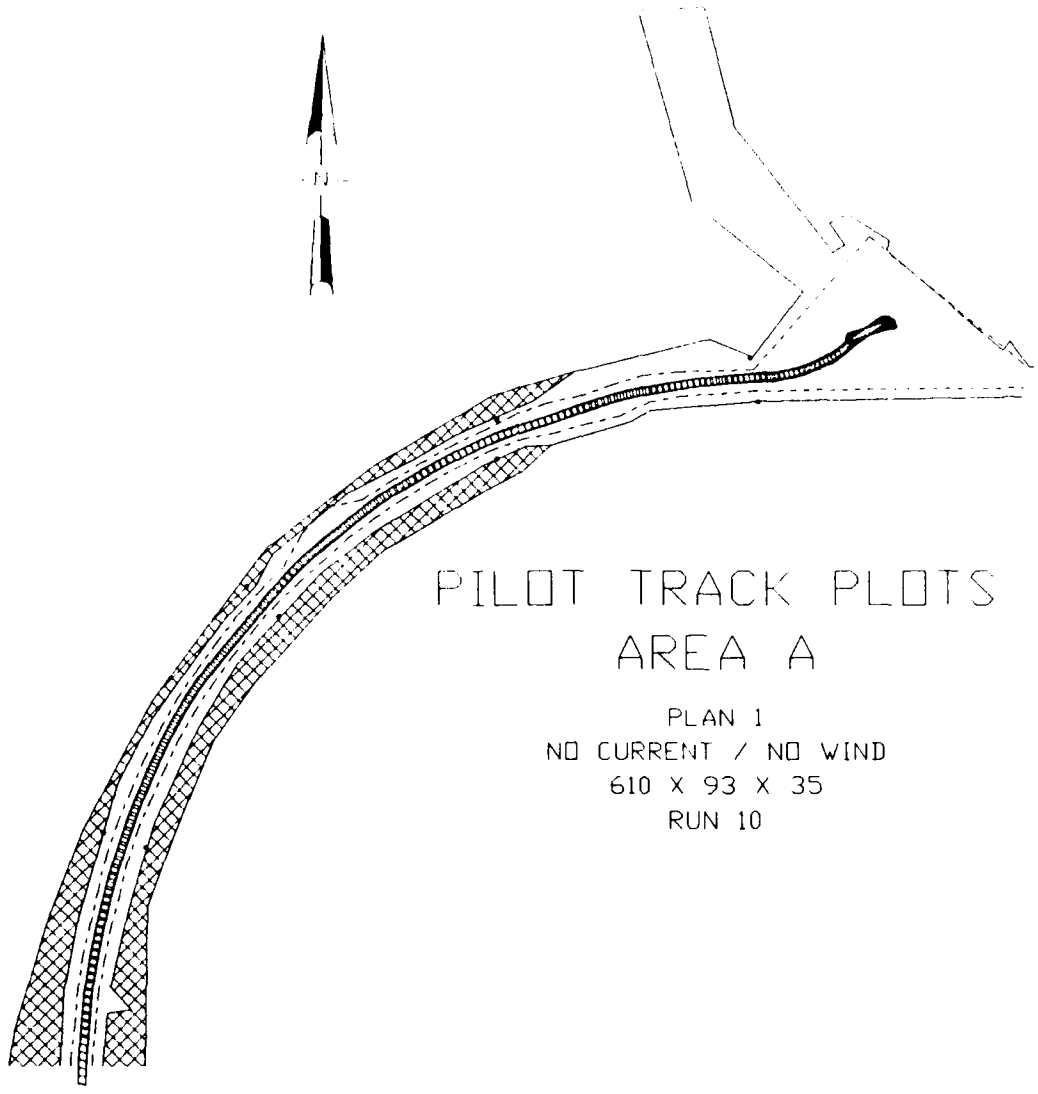

PILOT TRACK PLOTS
AREA A
PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 9
N

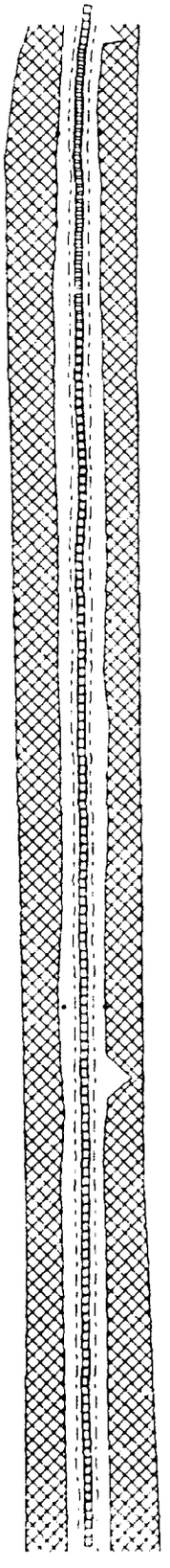
PLATE B94

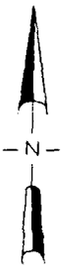


PILOT TRACK PLOTS
AREA A

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 10

PLATE B95



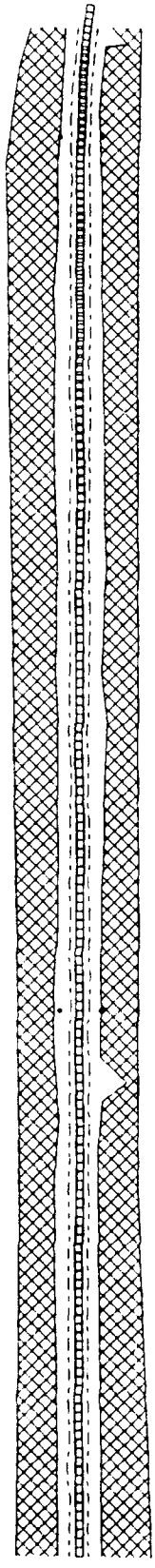


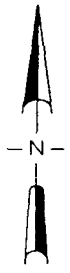
PILOT TRACK PLOTS

AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 1

PLATE B96

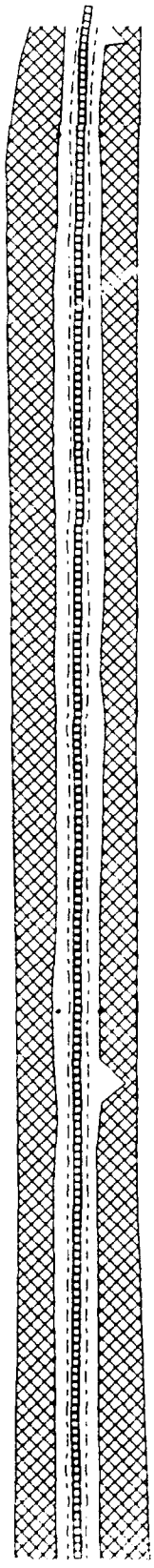


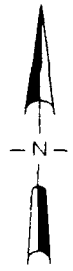


PILOT TRACK PLOTS
AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 2

PLATE B97

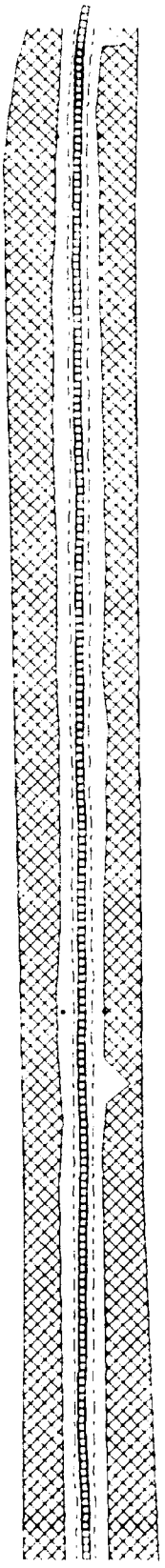


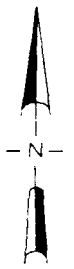


PILOT TRACK PLOTS
AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 3

PLATE B98



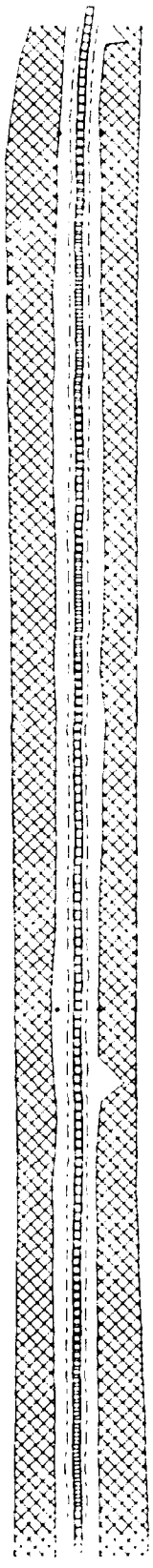


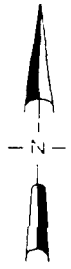
PILOT TRACK PLOTS

AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 4

PLATE B99



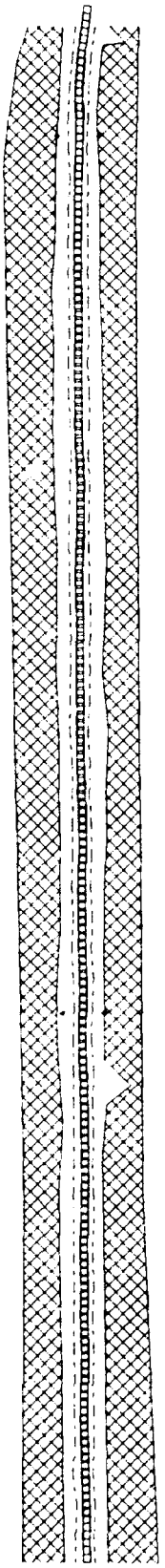


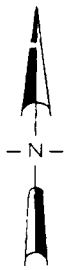
PILOT TRACK PLOTS

AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 5

PLATE B100



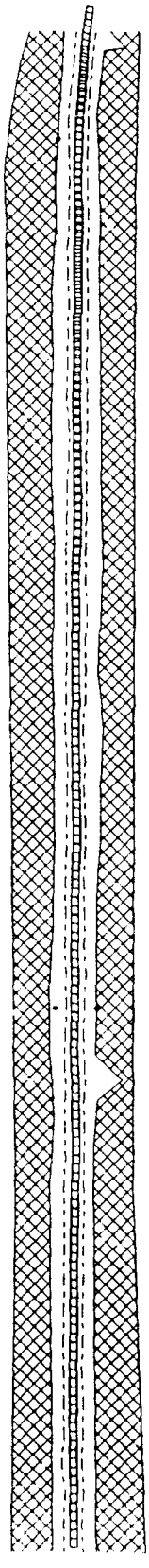


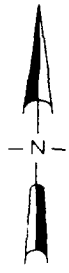
PILOT TRACK PLOTS

AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 6

PLATE B101

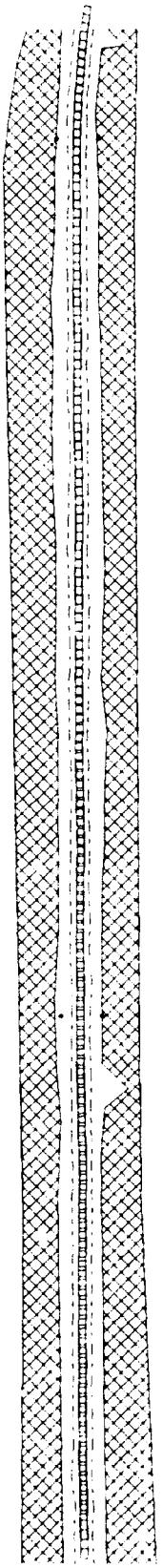


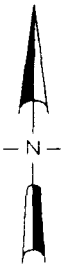


PILOT TRACK PLOTS
AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 7

PLATE B102

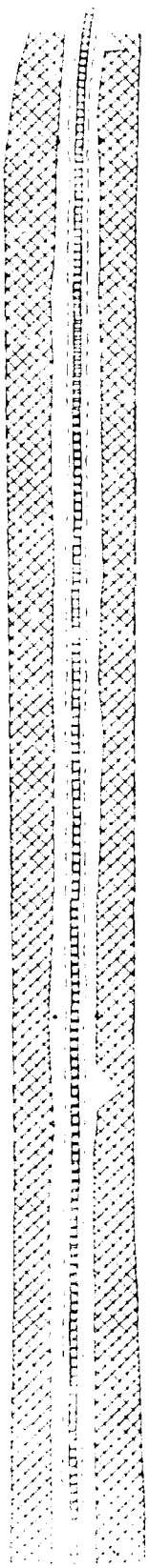




PILOT TRACK PLOTS
AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 8

PLATE B103

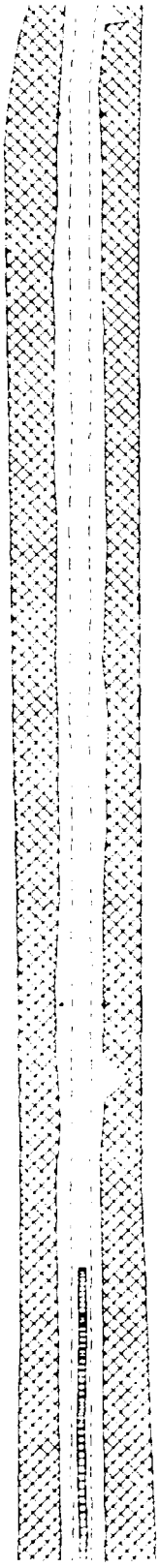


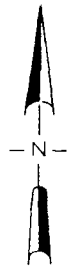
PILOT TRACK PLOTS

AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 9

PLATE B104

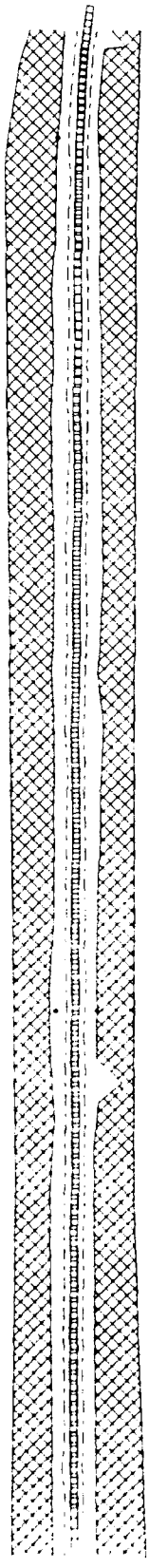


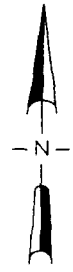


PILOT TRACK PLOTS
AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 10

PLATE B105

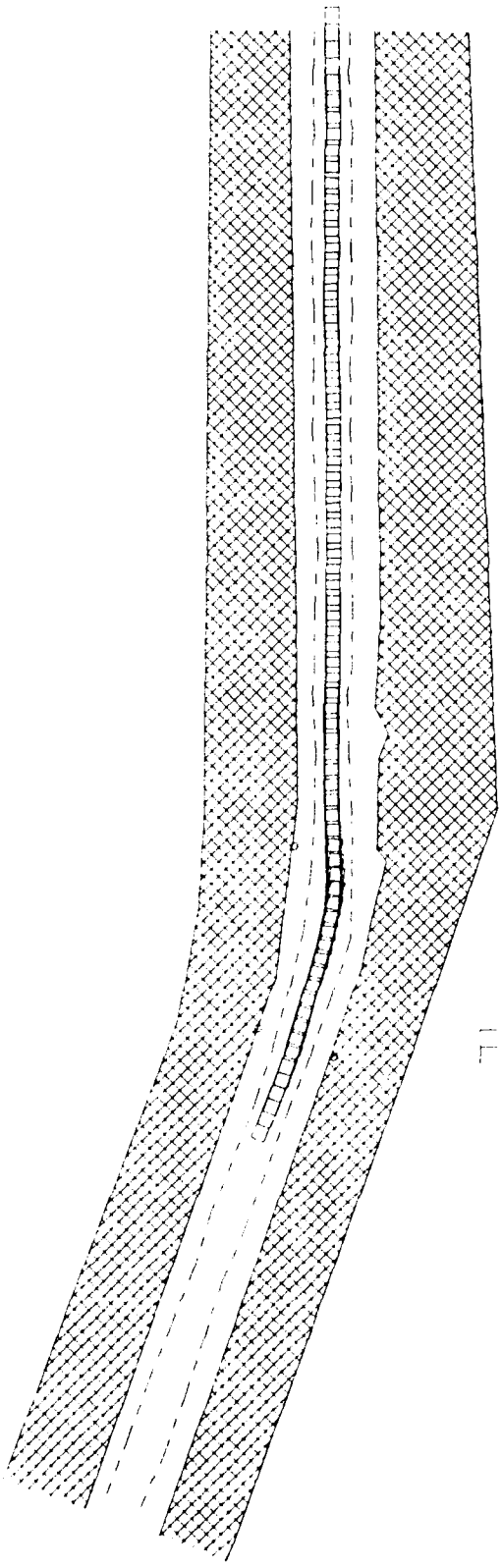


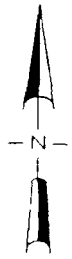


PILOT TRACK PLOTS
AREA B

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 11

PLATE B106

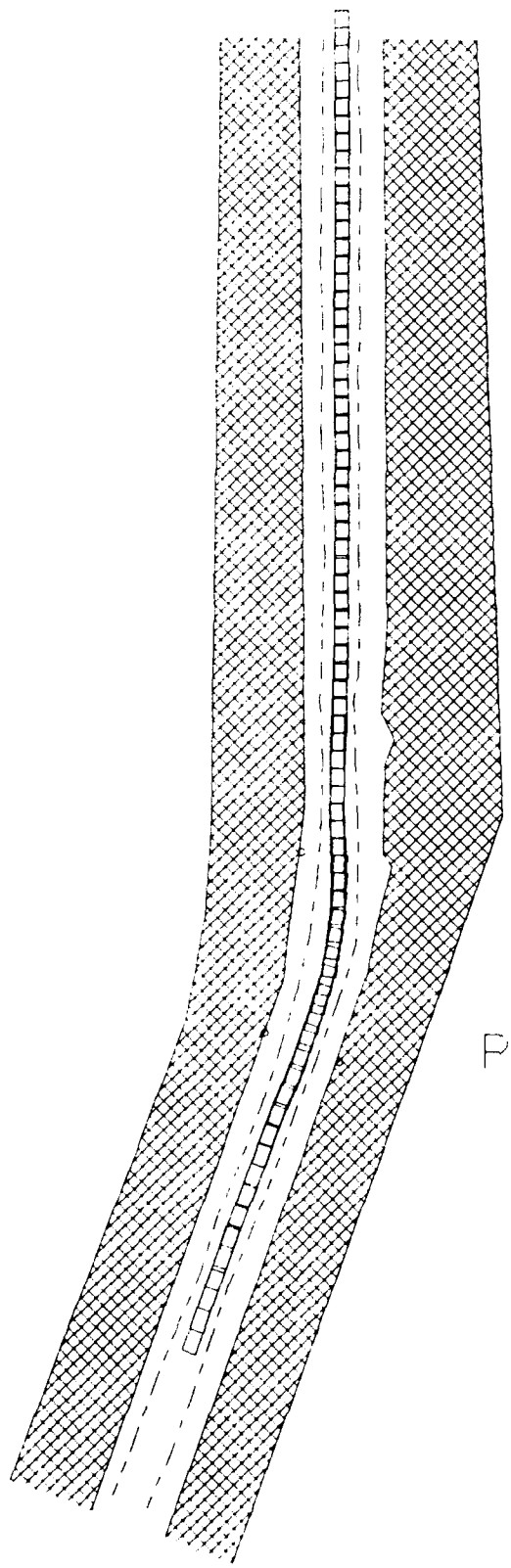


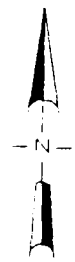


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 1

PLATE B107

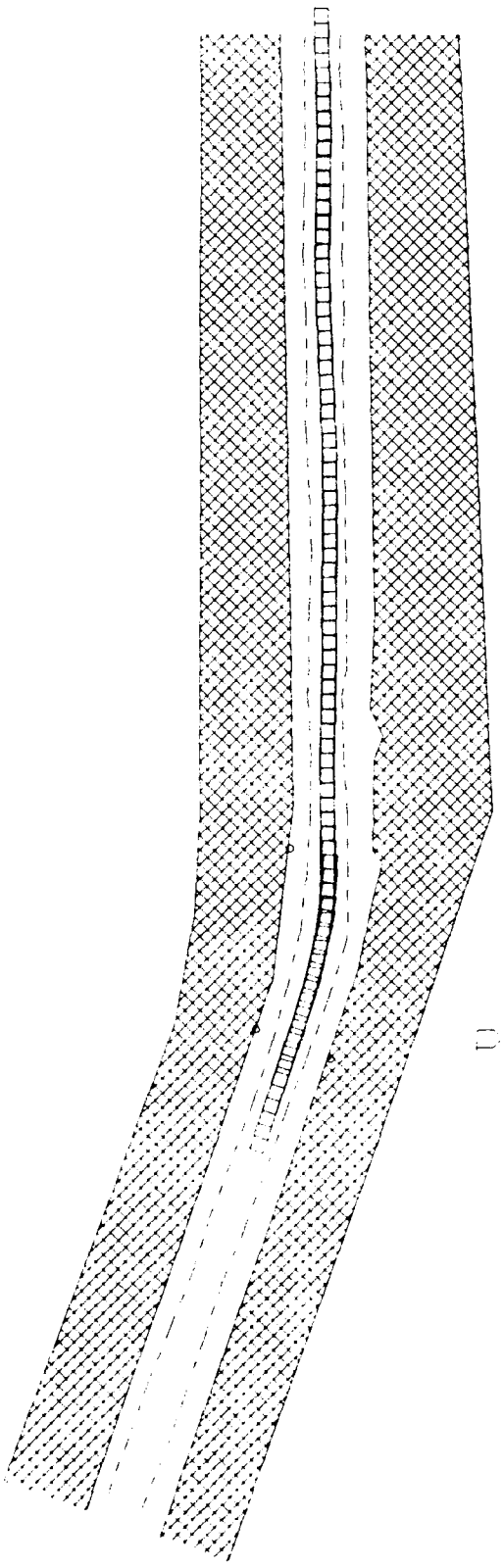


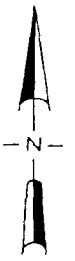


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 2

PLATE B108

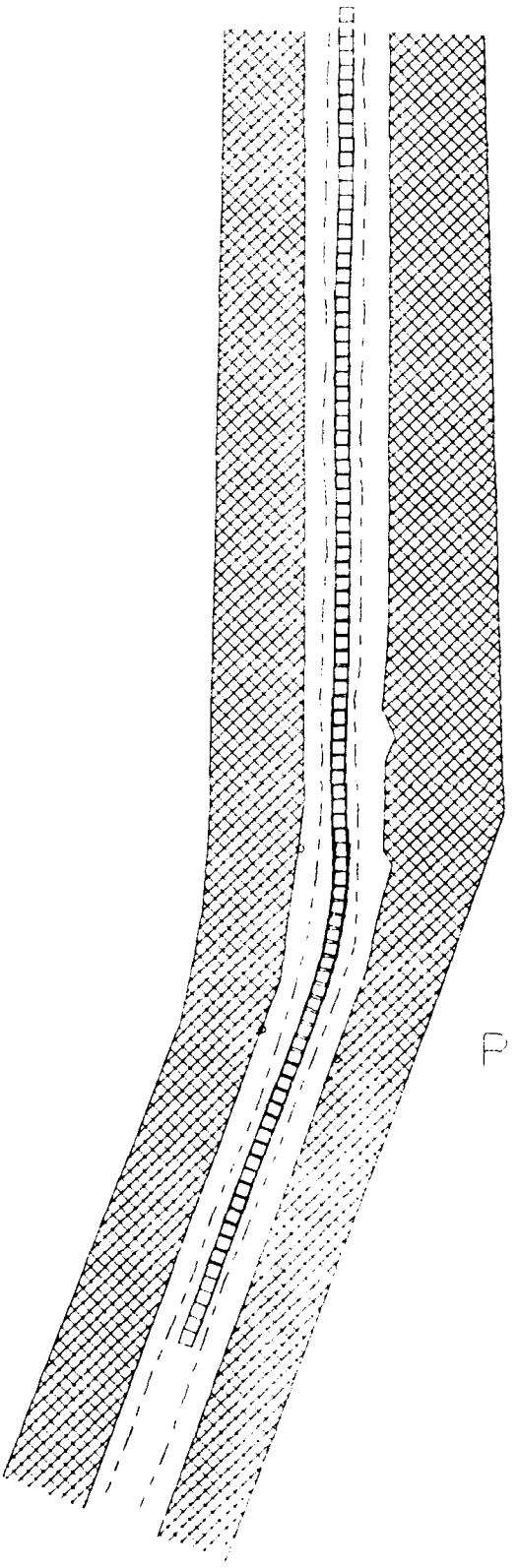


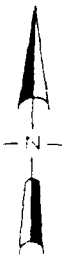


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 3

PLATE B109

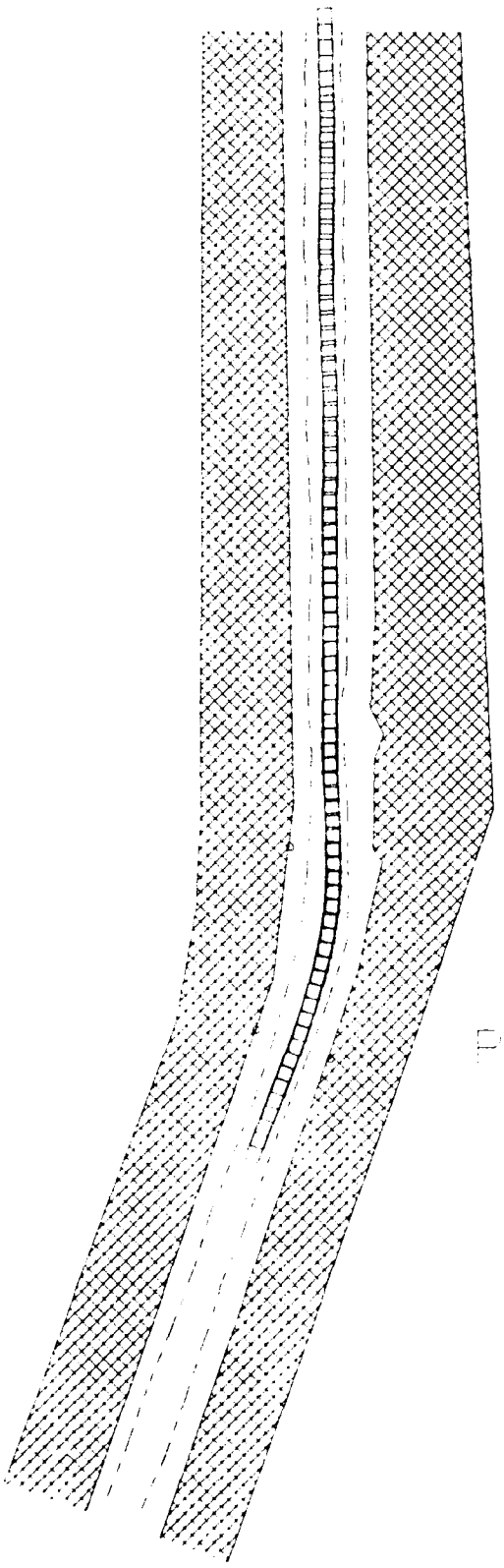


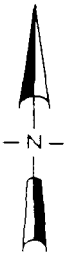


PILOT TRACK PLOT
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 90 X 35
RUN 4

PLATE B110

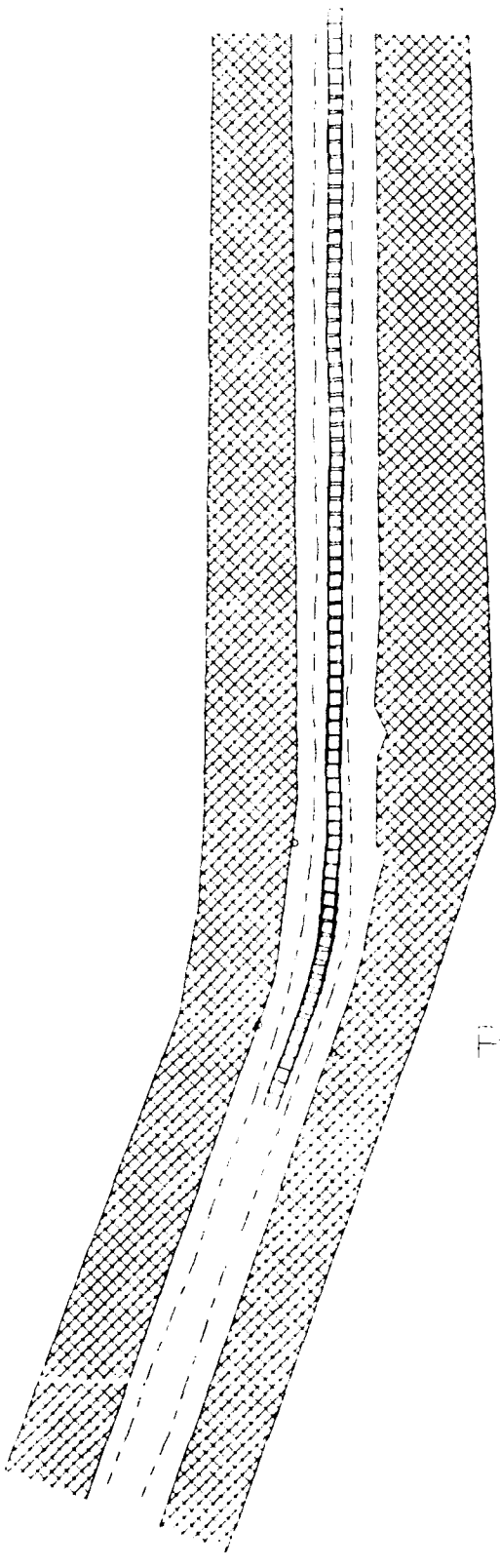


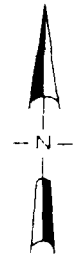


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 5

PLATE B111

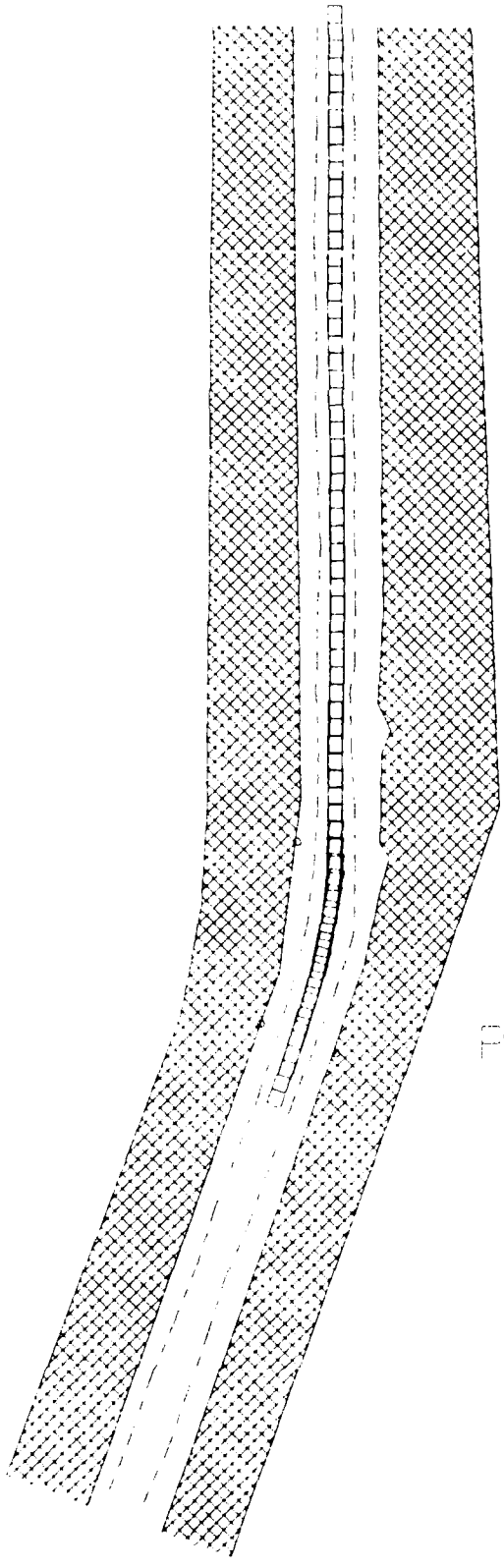


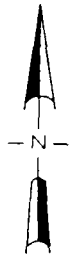


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 6

PLATE B112

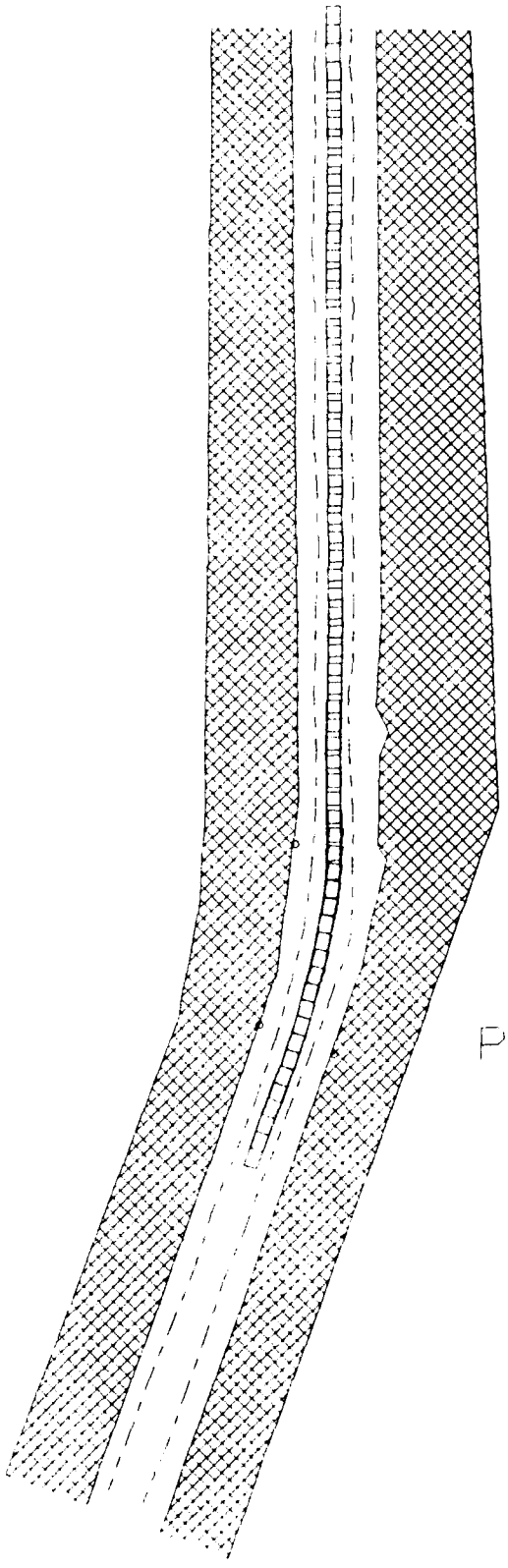


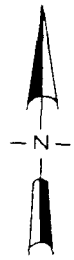


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 7

PLATE B113

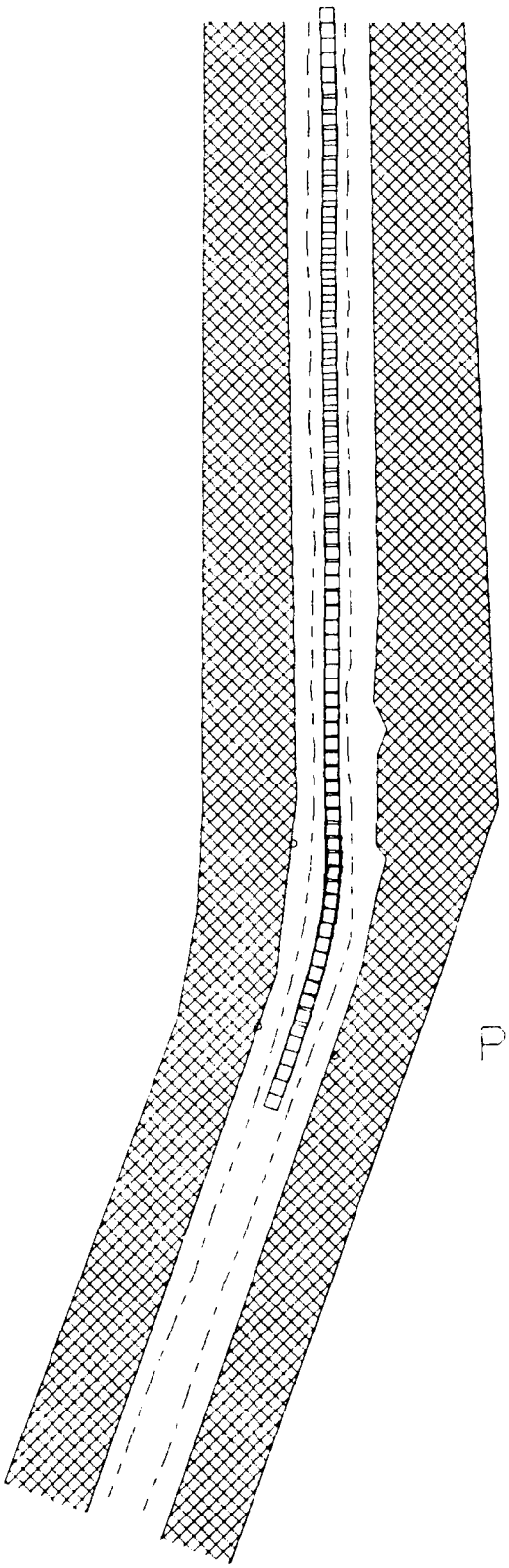


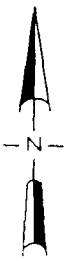


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 8

PLATE B114

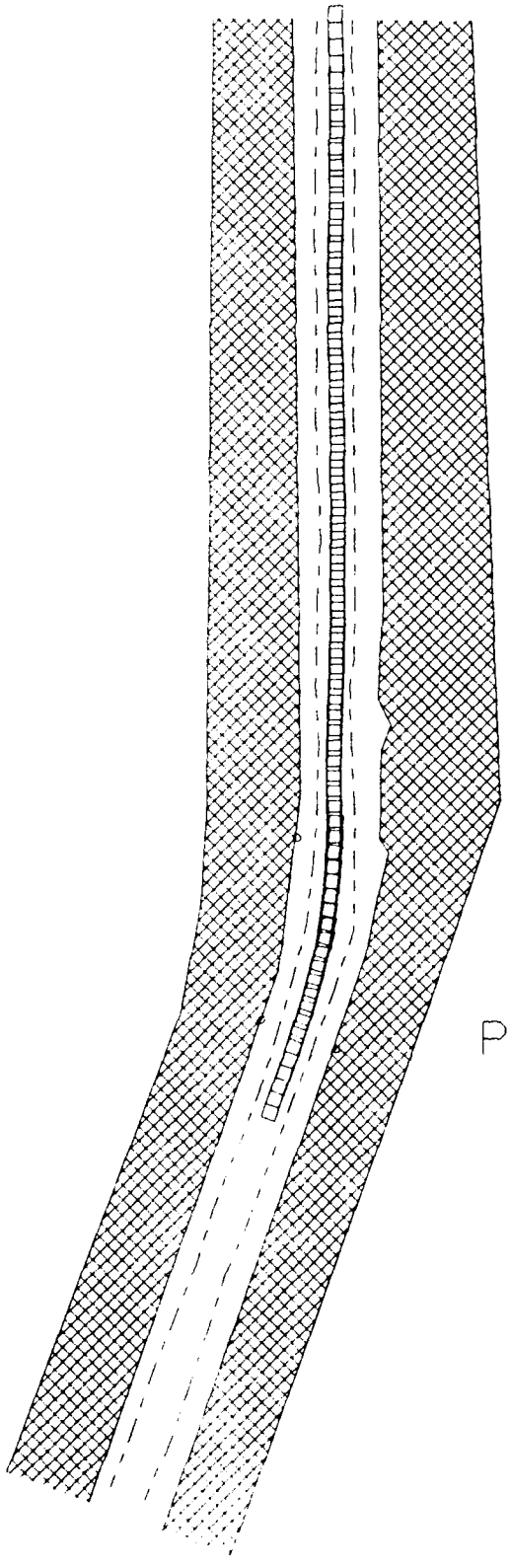


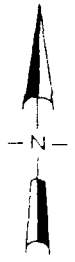


PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 9

PLATE B115





PILOT TRACK PLOTS
AREA C

PLAN 1
NO CURRENT / NO WIND
610 X 93 X 35
RUN 10

PLATE B116

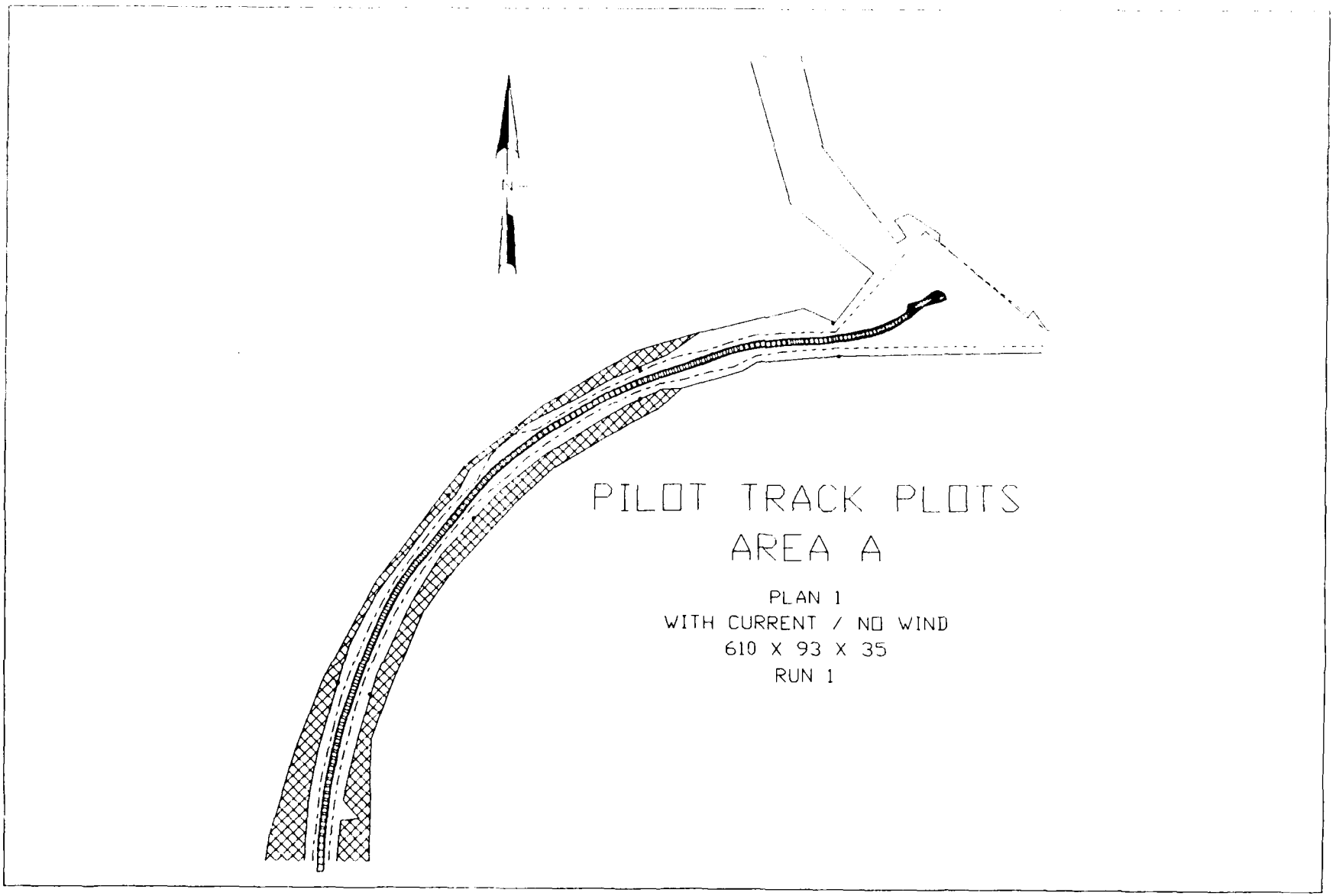
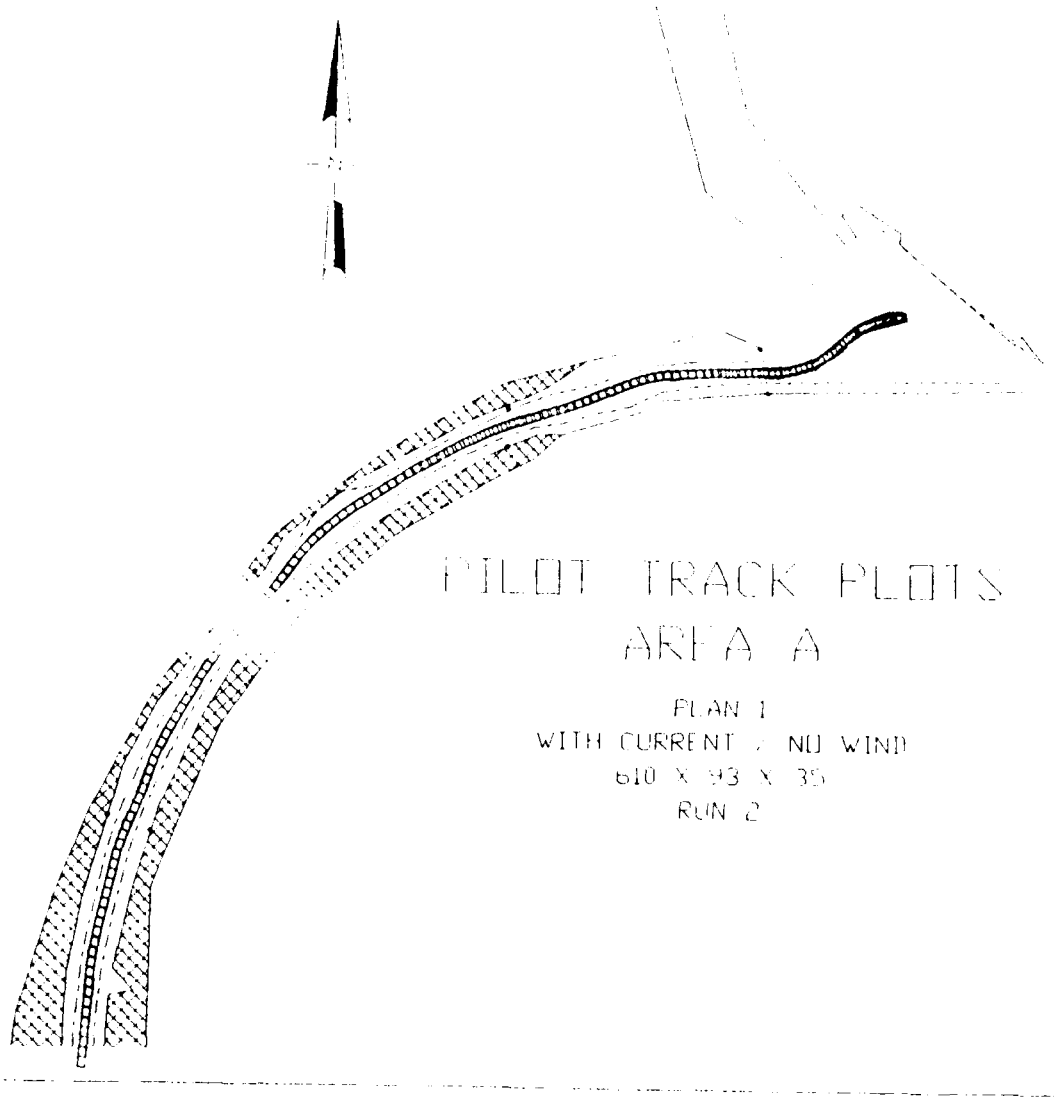

PILOT TRACK PLOTS
AREA A
PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 1

PLATE B117

PLATE B118



PILOT TRACK PLOTS

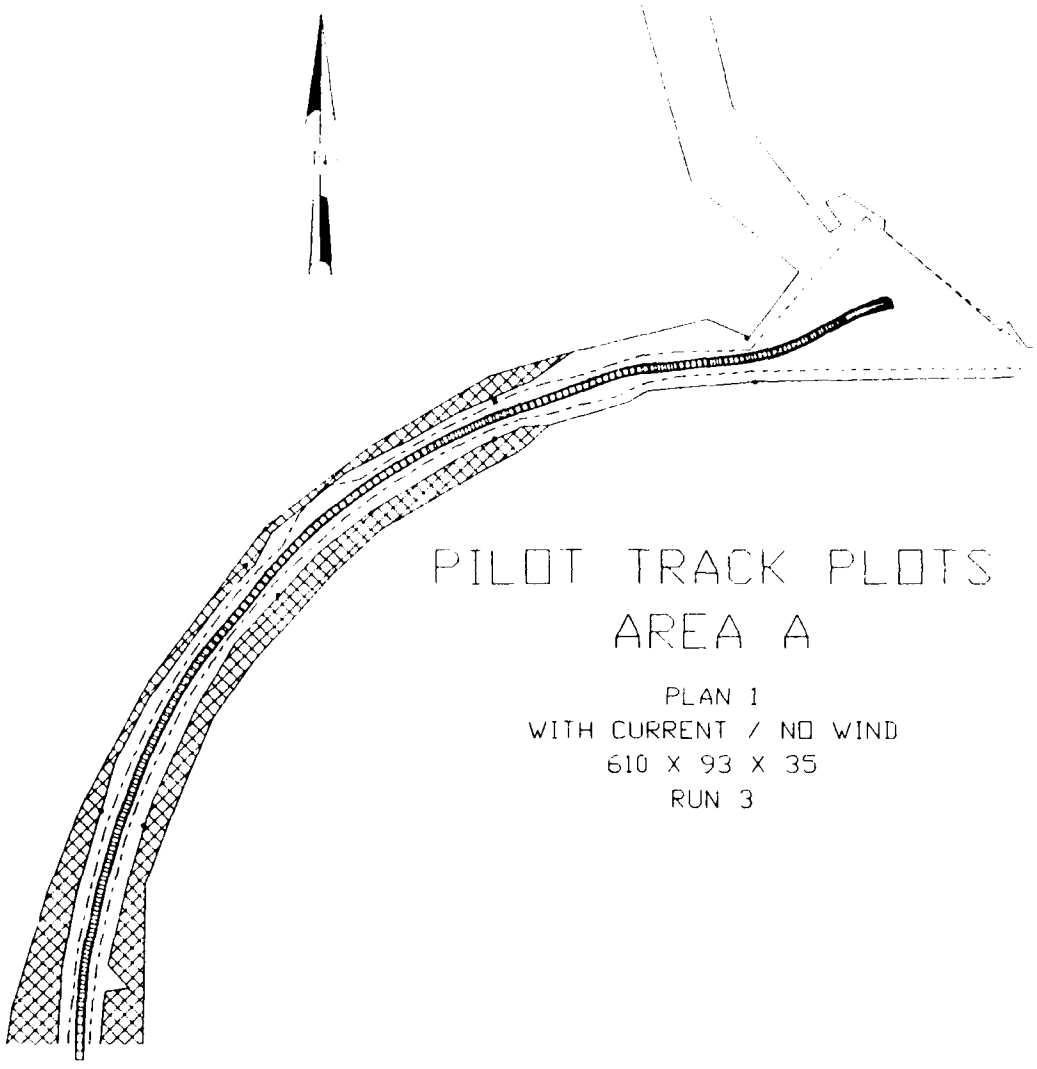
AREA A

PLAN 1

WITH CURRENT / NO WIND

610 X 93 X 35

RUN 2

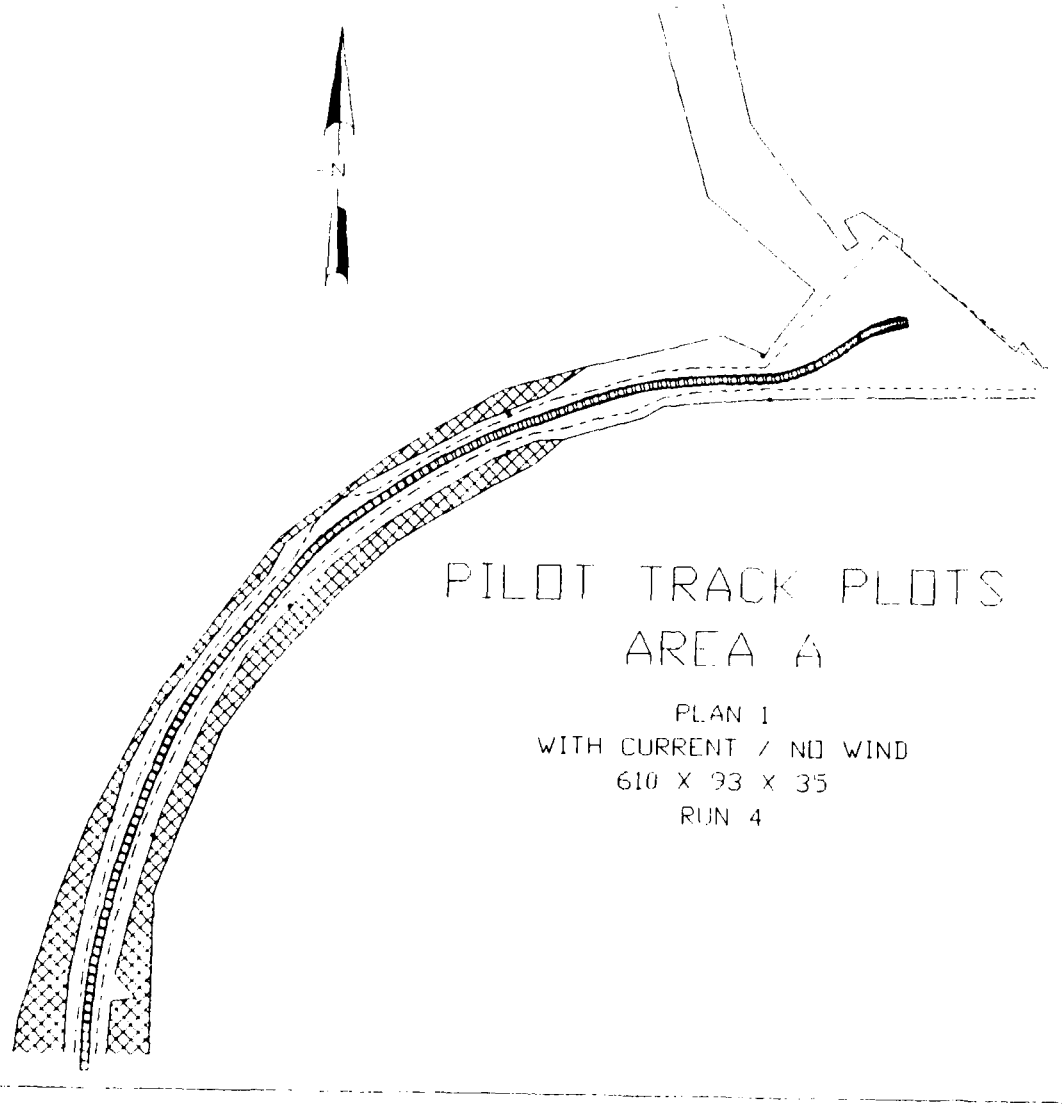


PILOT TRACK PLOTS
AREA A

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 3

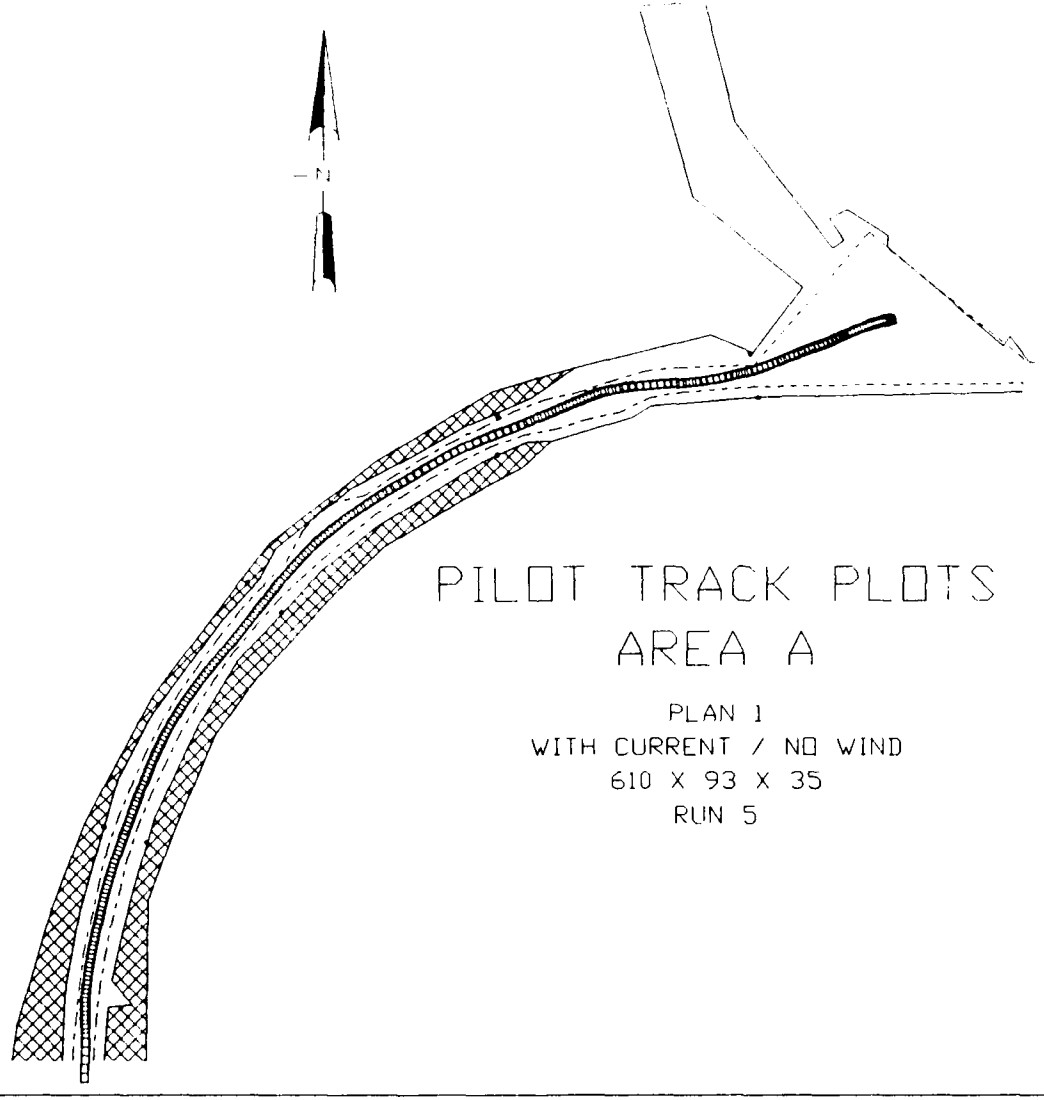
PLATE B119

PLATE B120



PILOT TRACK PLOTS
AREA A

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 4

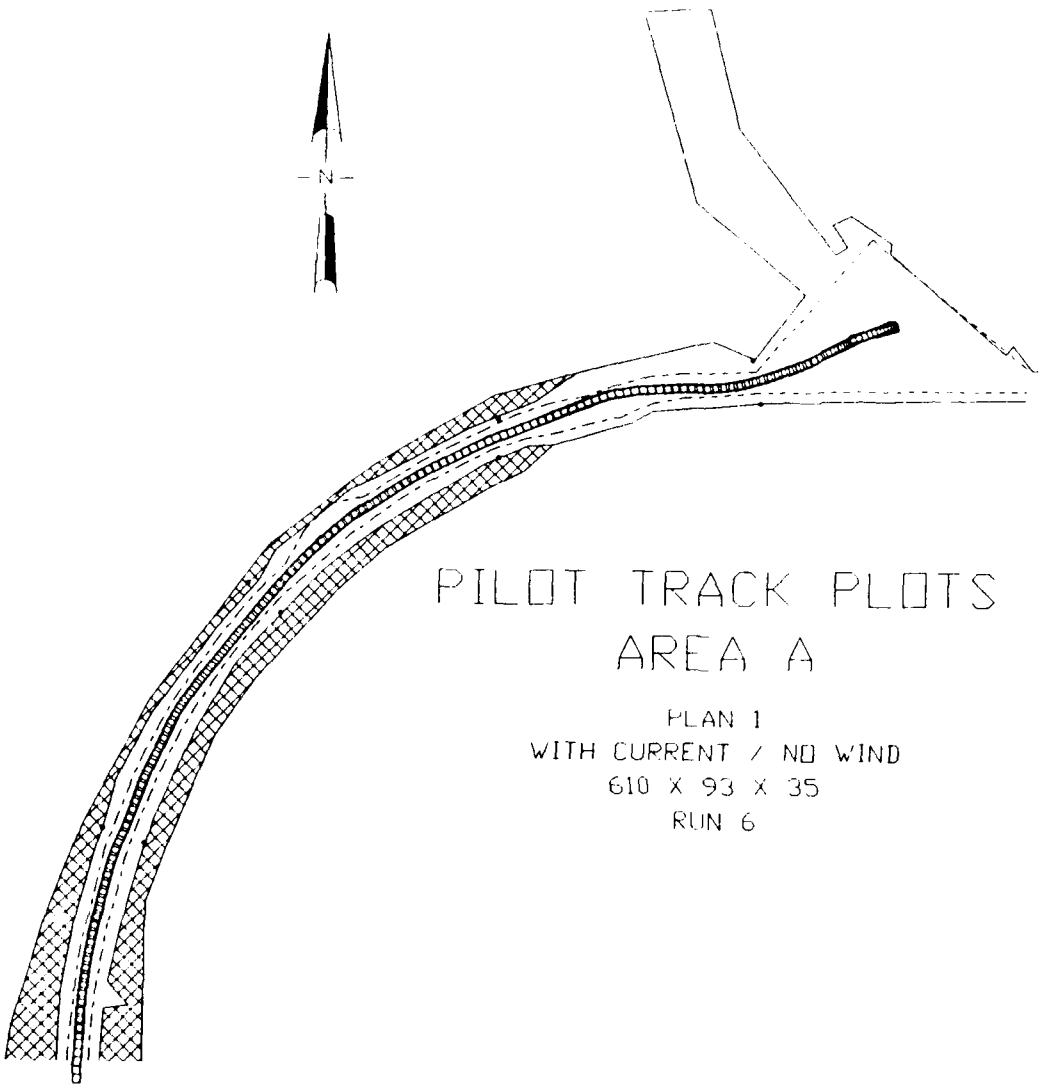


PILOT TRACK PLOTS
AREA A

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 5

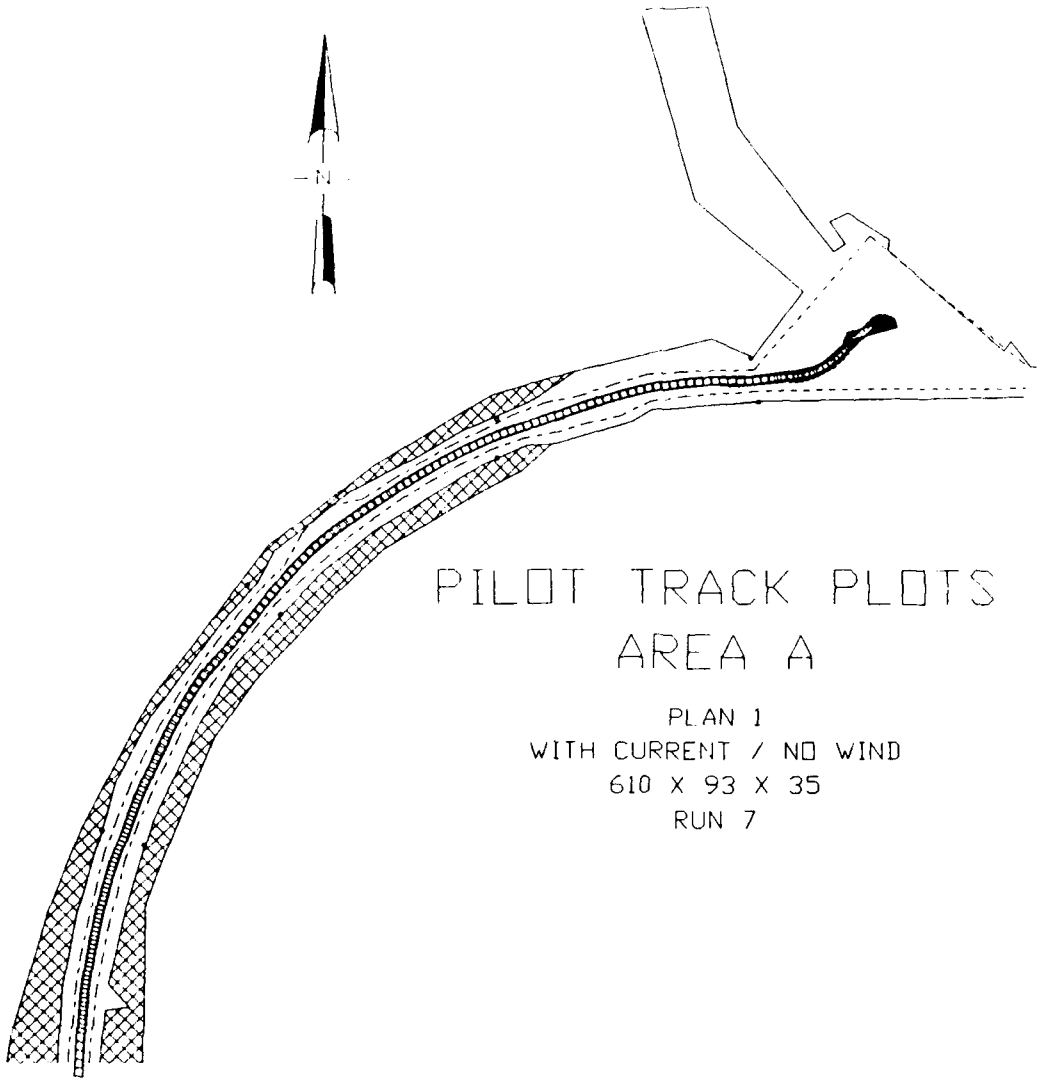
PLATE B121

PLATE B122



PILOT TRACK PLOTS
AREA A

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 6

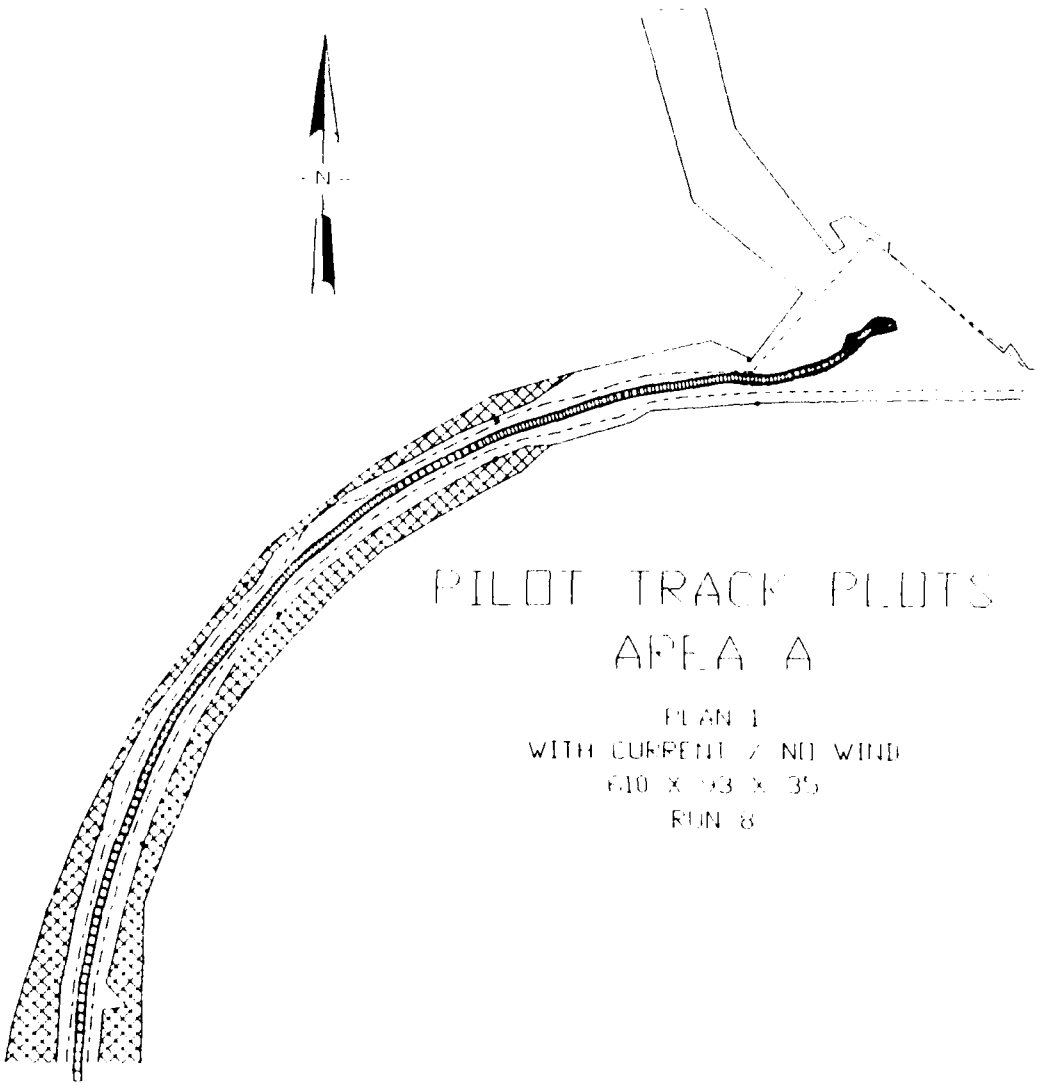


PILOT TRACK PLOTS
AREA A

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 7

PLATE B123

PLATE B124



PILOT TRACK PLOTS

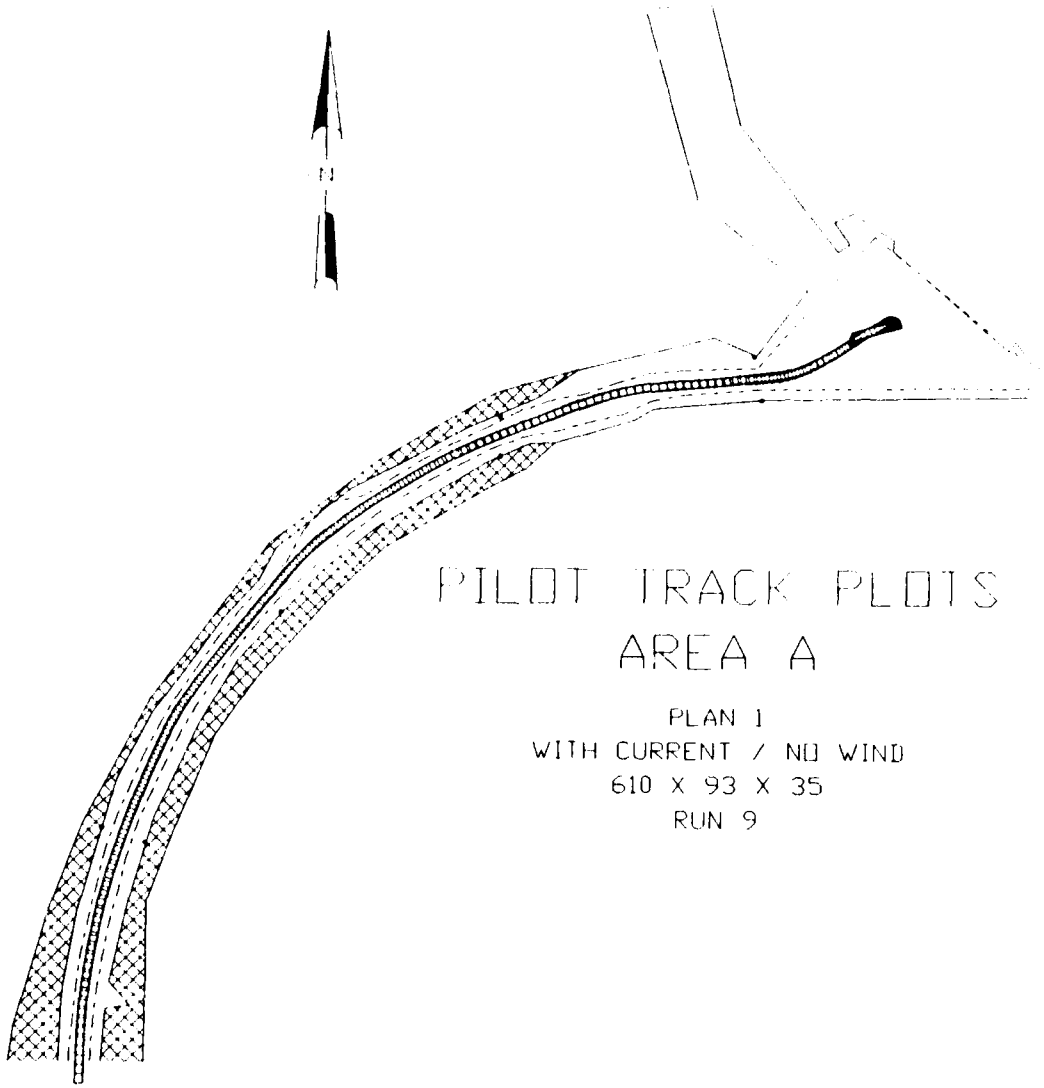
APEA A

PLAN 1

WITH CURRENT / NO WIND

610 X 93 X 35

RUN 8



PILOT TRACK PLOTS
AREA A

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 9

PLATE B125

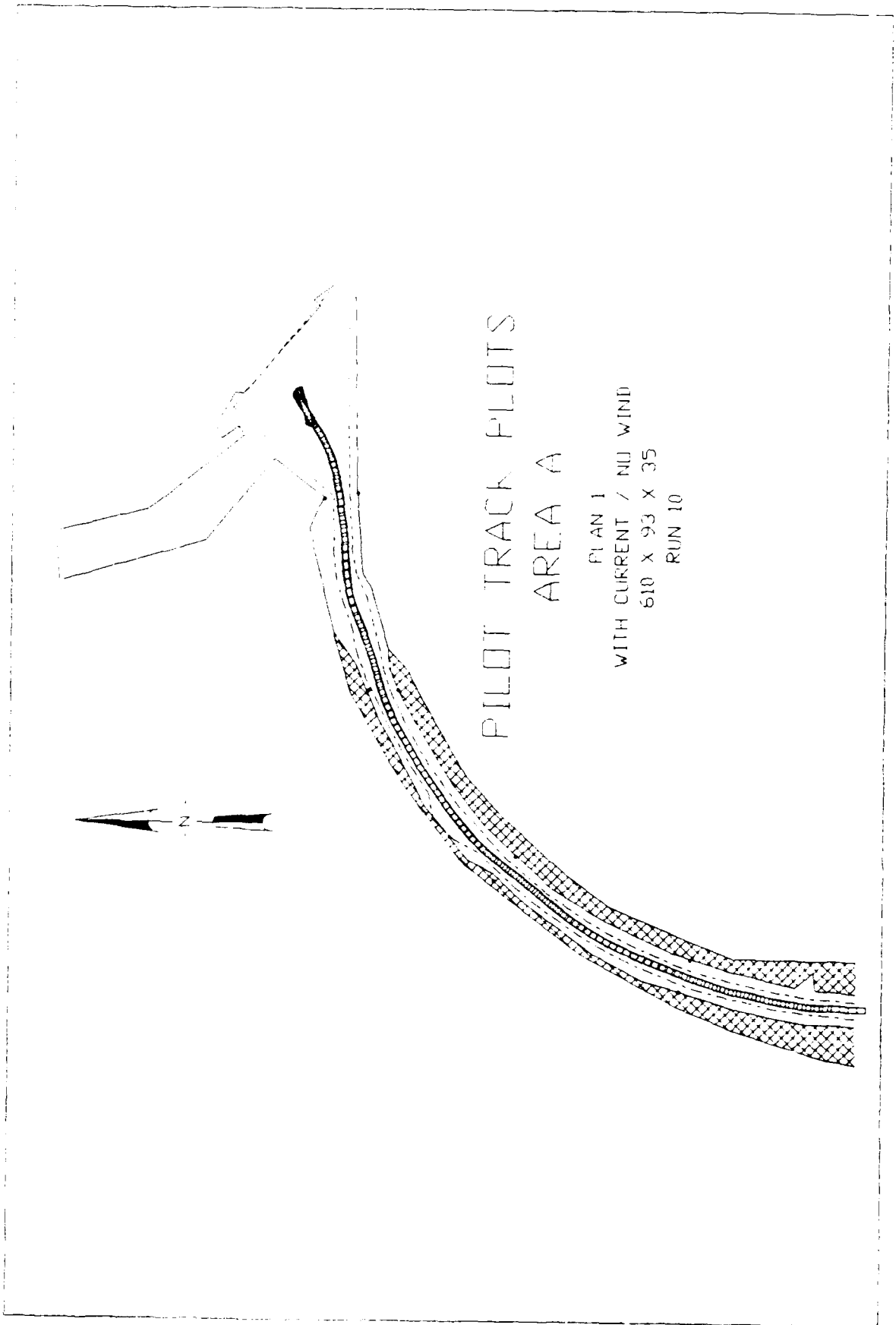

PILOT TRACK PLOTS
AREA A
PLAN 1
WITH CURRENT / NO WIND
610 x 93 x 35
RUN 10
N

PLATE B126

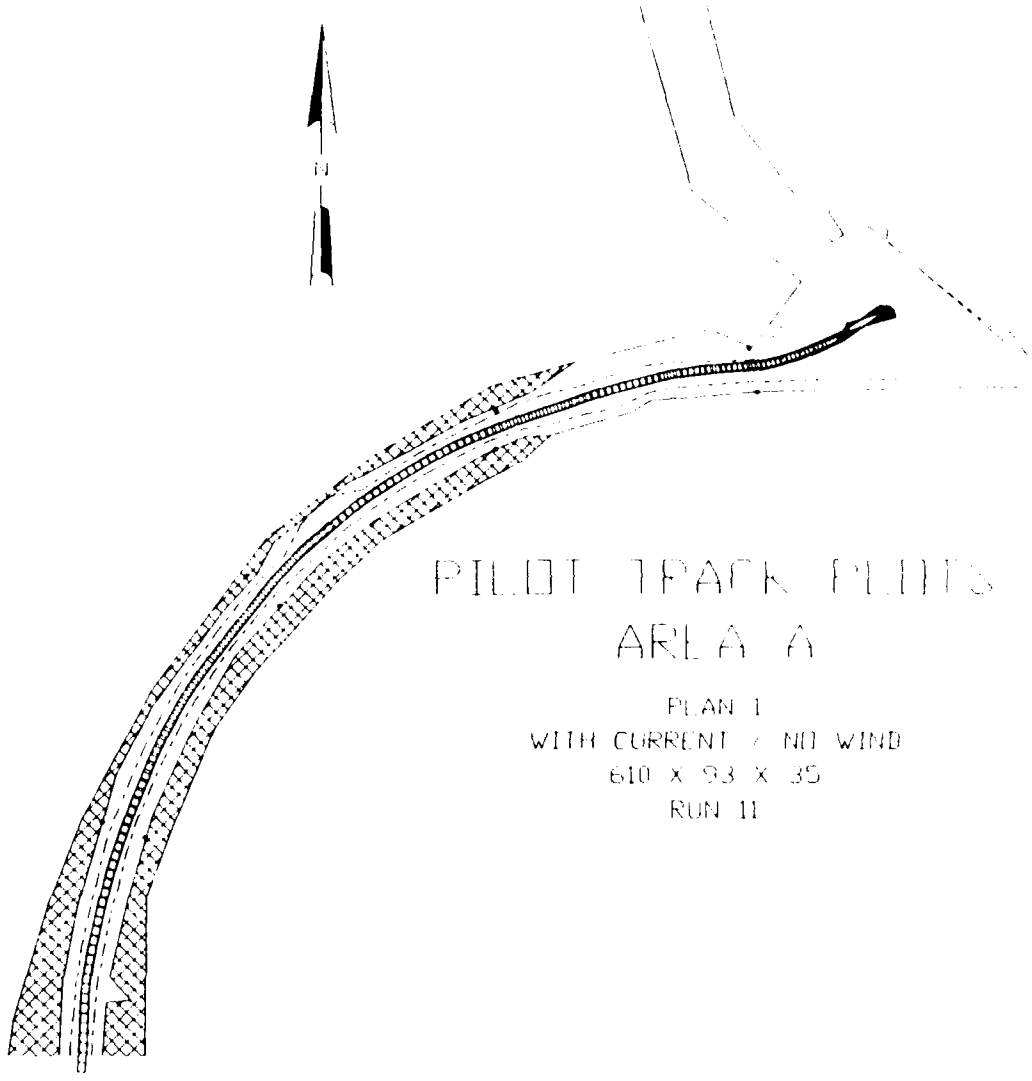
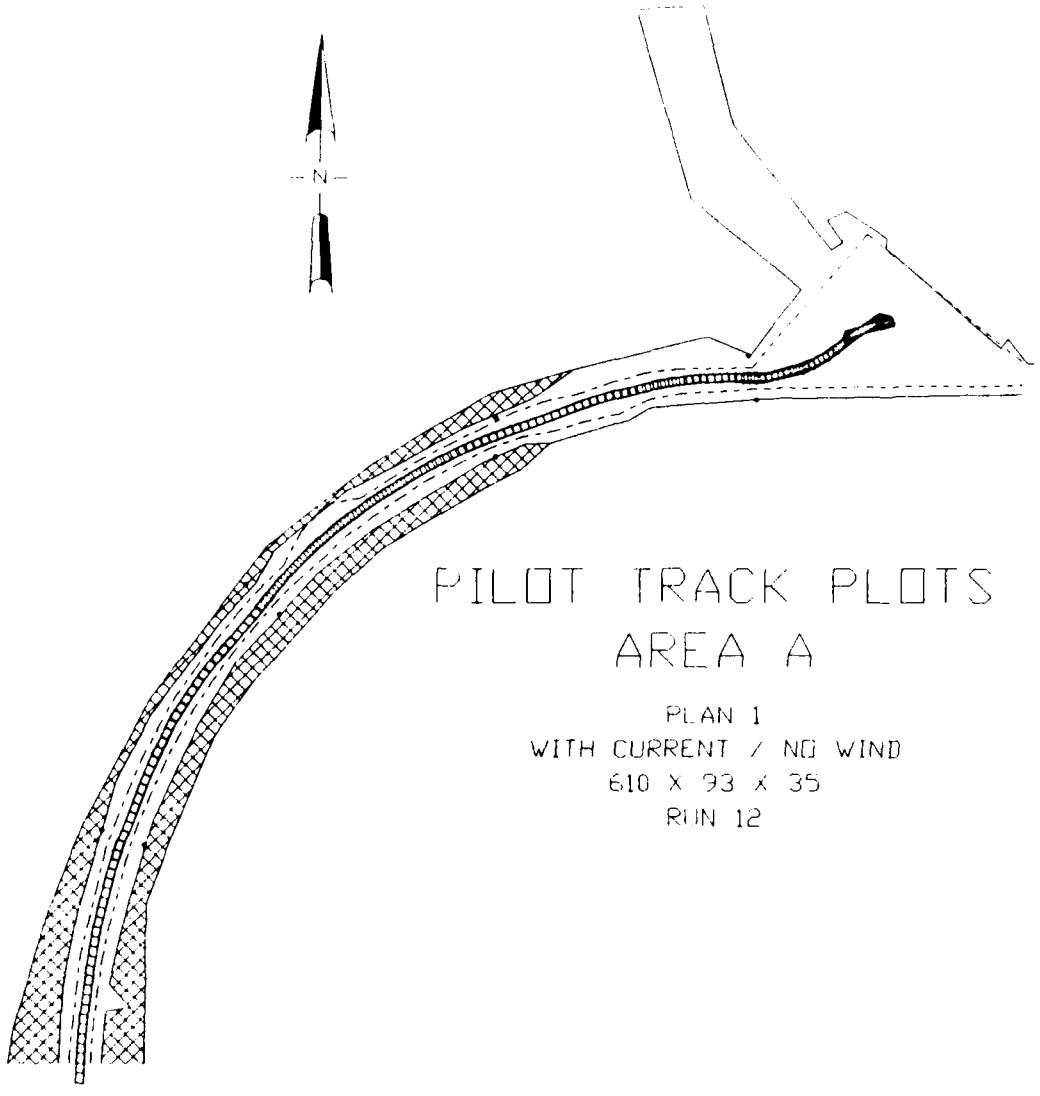

N
PILOT TRACK PLOTS
AREA A
PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 11

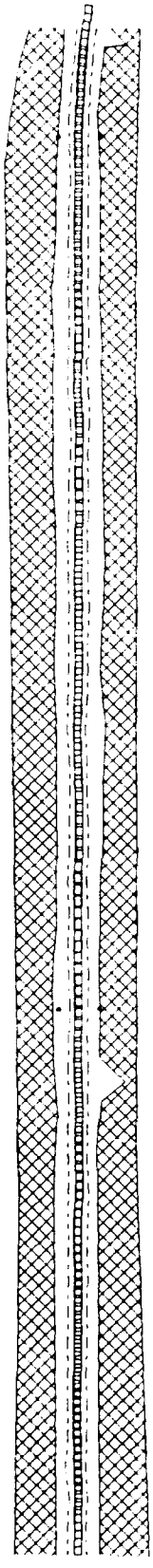
PLATE B127

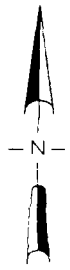
PLATE B128



PILOT TRACK PLOTS
AREA A

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 12

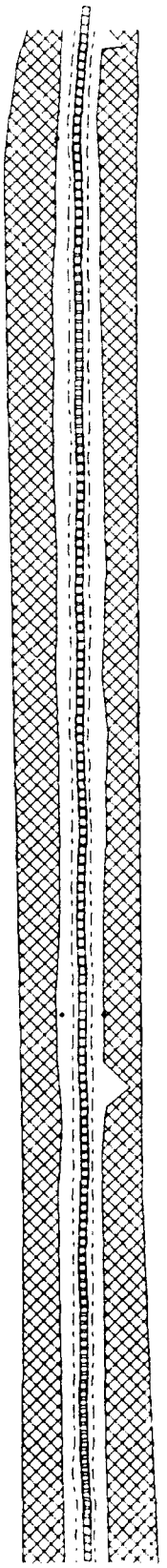




PILOT TRACK PLOTS
AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 1

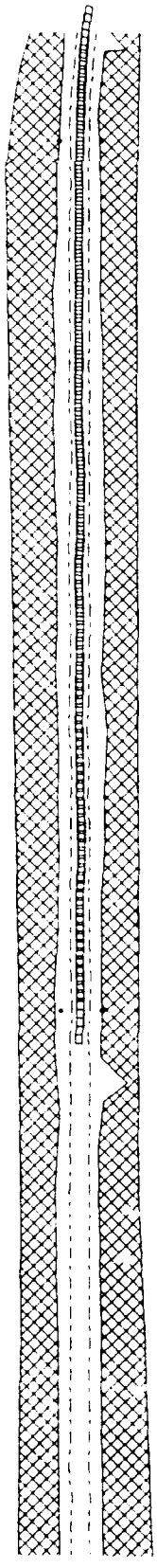
PLATE B129

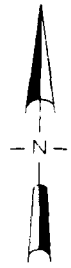


PILOT TRACK PLOTS
AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 2

PLATE B130



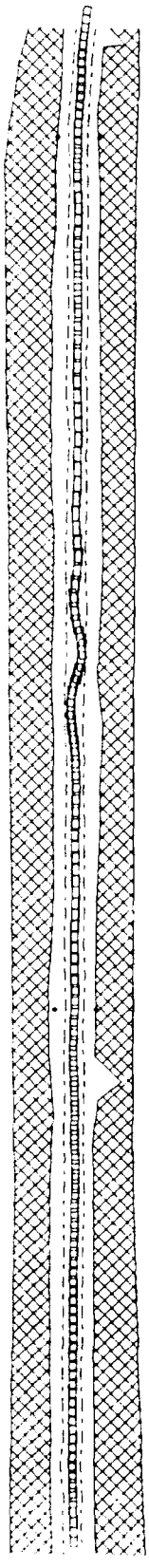


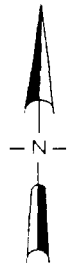
PILOT TRACK PLOTS

AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 3

PLATE B131



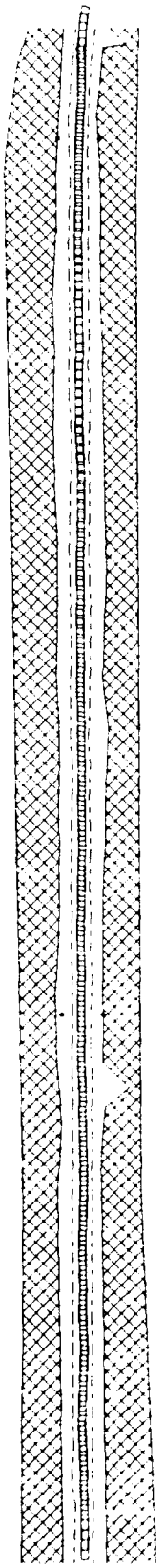


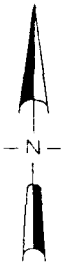
PILOT TRACK PLOTS

AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 4

PLATE B132



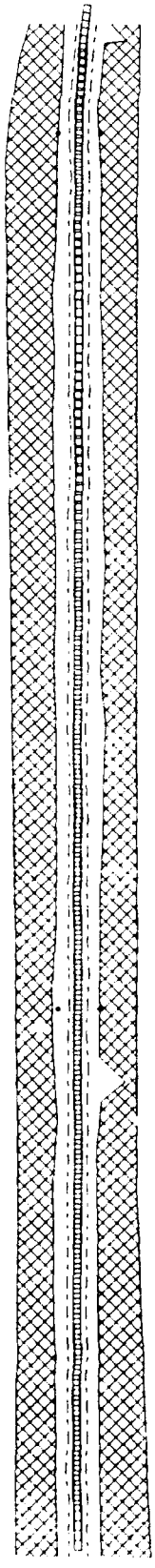


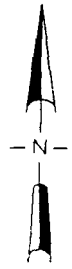
PILOT TRACK PLOTS

AREA B

PLAN I
WITH WIND / NO WIND
610 X 93 X 35
RUN 5

PLATE B133

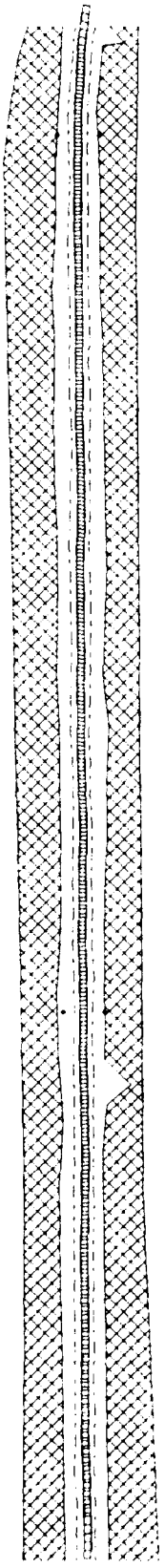


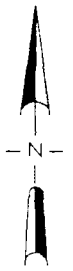


PILOT TRACK PLOTS
AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 6

PLATE B134



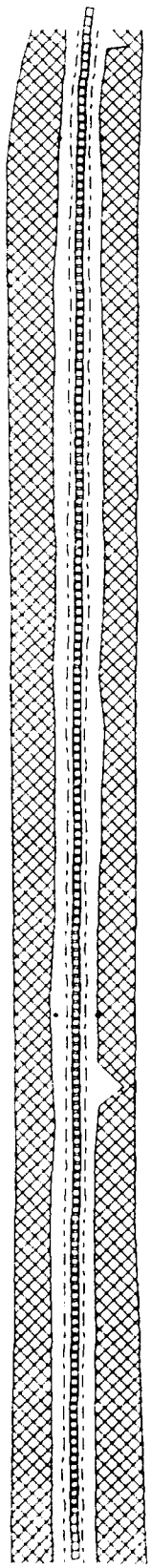


PILOT TRACK PLOTS

AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 7

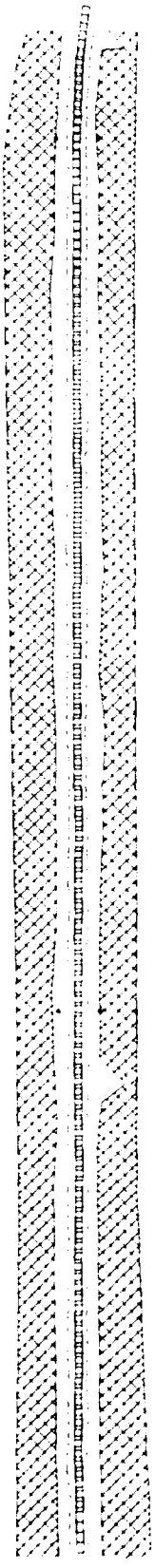
PLATE B135

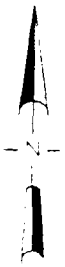


PILOT TRACK PLOTS
AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 8

PLATE B136





PILOT TRACK PLOTS

AREA B

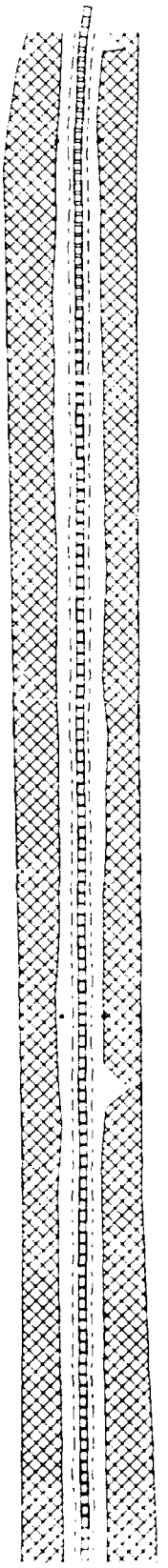
PLAN 1

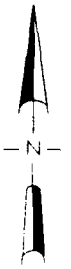
WITH WIND / NO WIND

810 / 93 / 35

RUN 9

PLATE B137



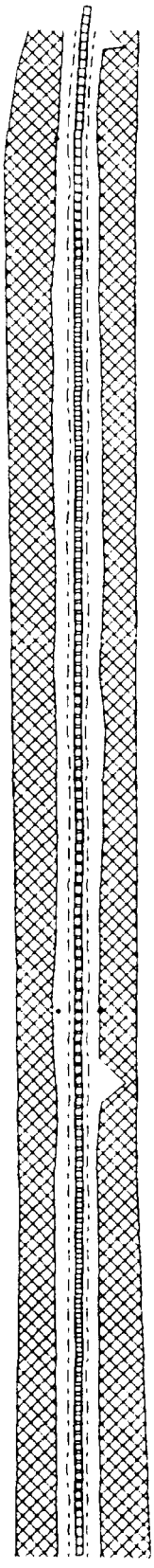


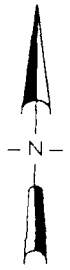
PILOT TRACK PLOTS

AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 10

PLATE B138

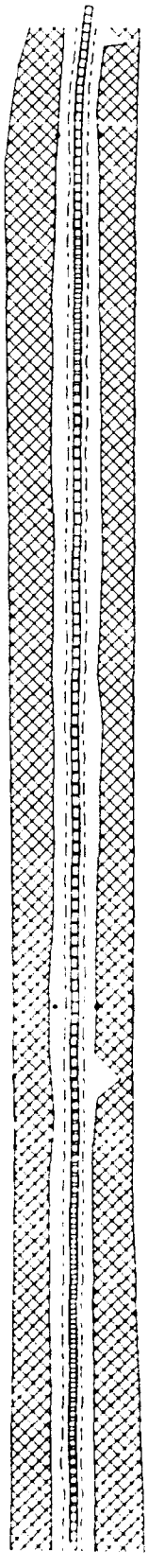


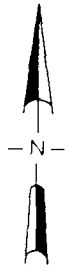


PILOT TRACK PLOTS
AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 11

PLATE B139

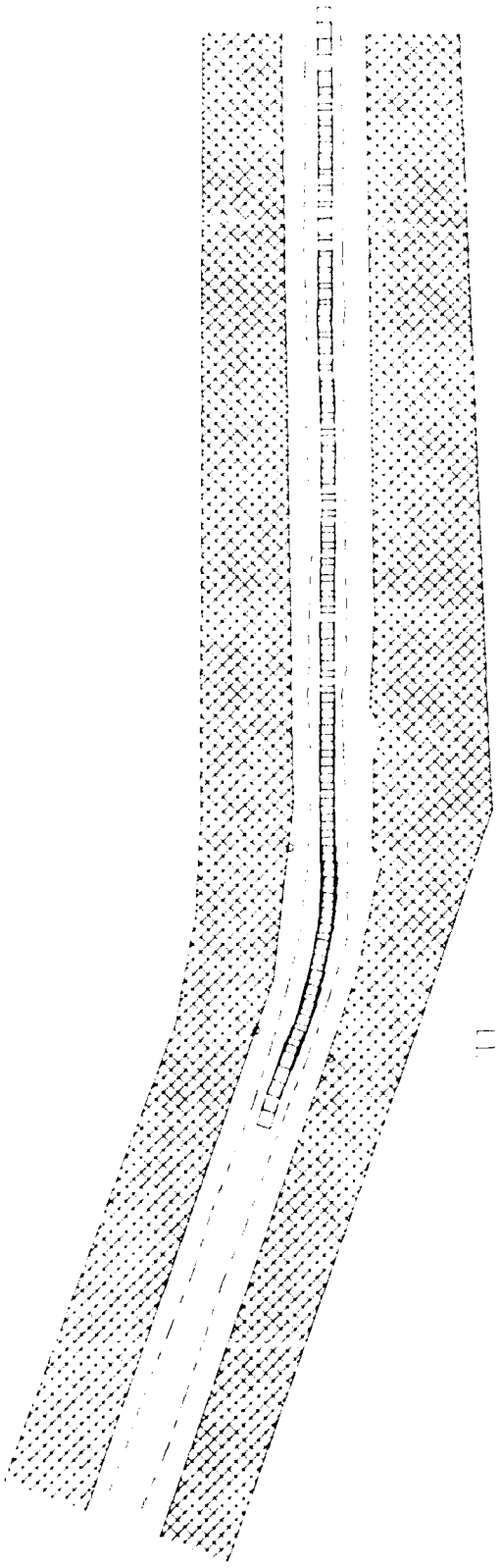


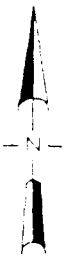


PILOT TRACK PLOTS
AREA B

PLAN 1
WITH WIND / NO WIND
610 X 93 X 35
RUN 12

PLATE B140





PILOT TRACK PLOTS

AREA I

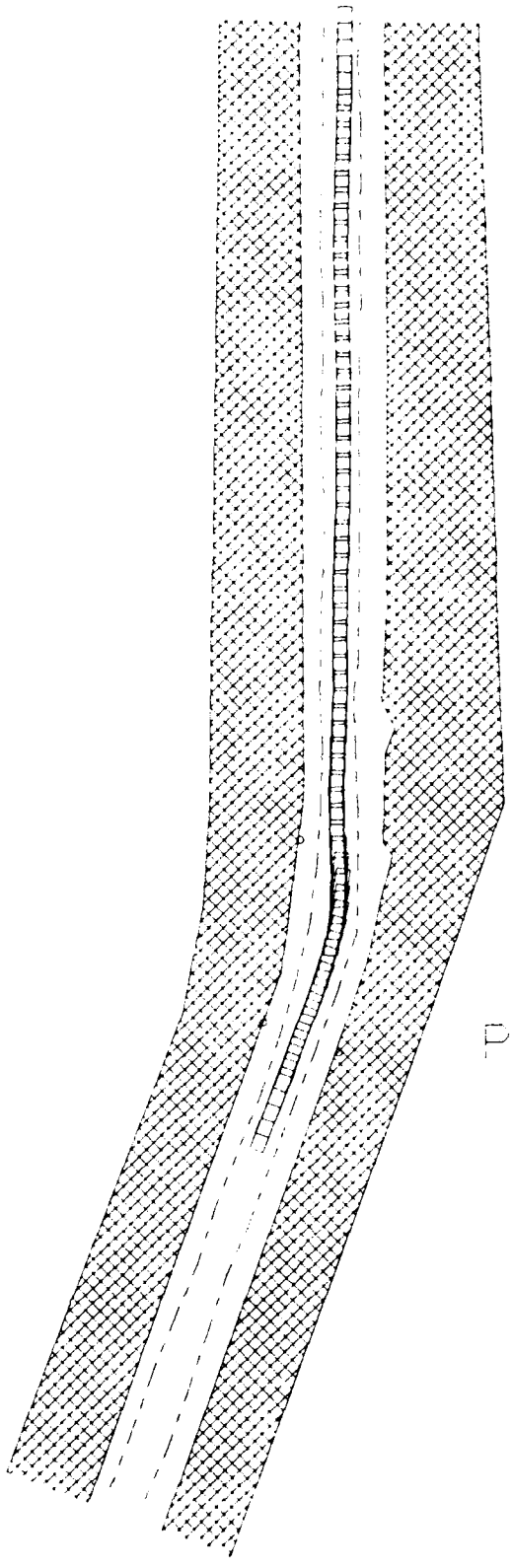
PLAN 1

WITH CURRENT / NO WIND

610 X 93 X 35

RUN 1

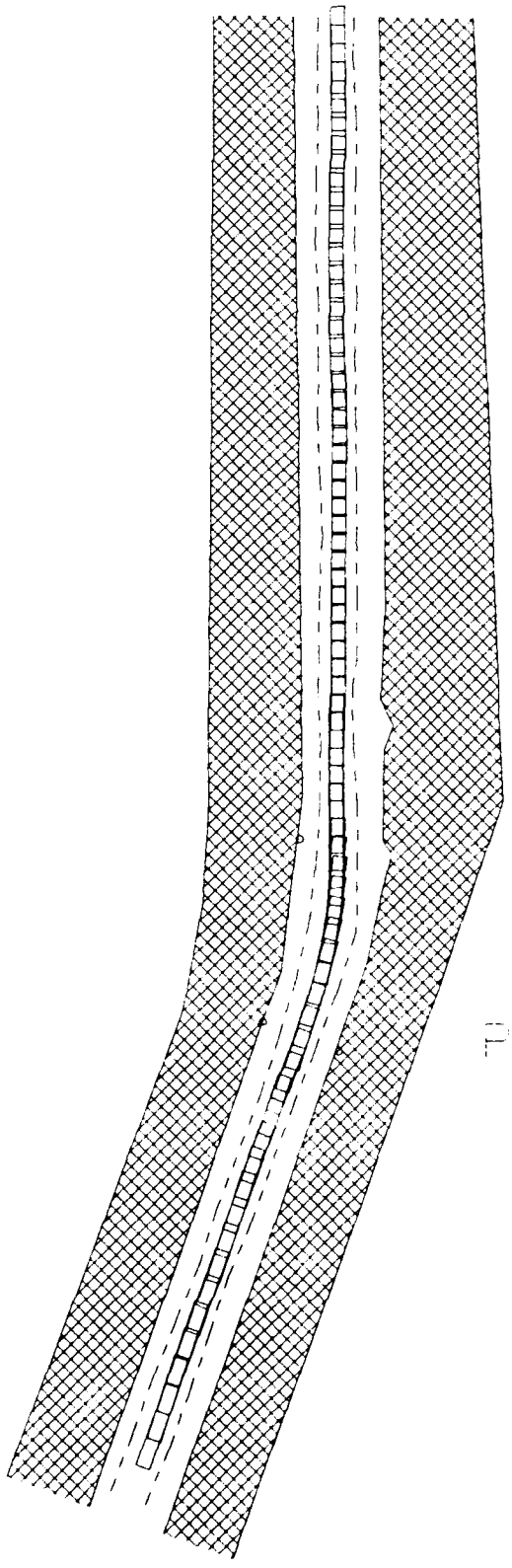
PLATE B141

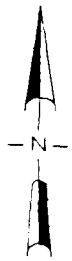


PILOT TRACK PLOT
AREA C

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 2

PLATE B142

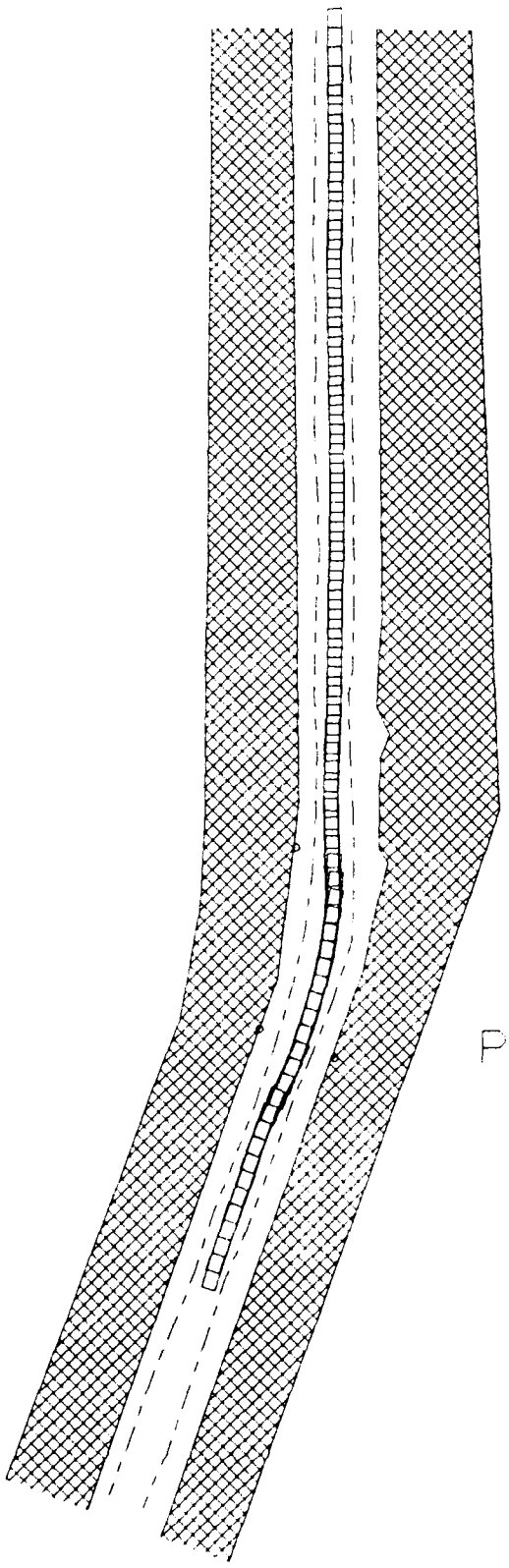




PILOT TRACK PLOTS
AREA C

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 4

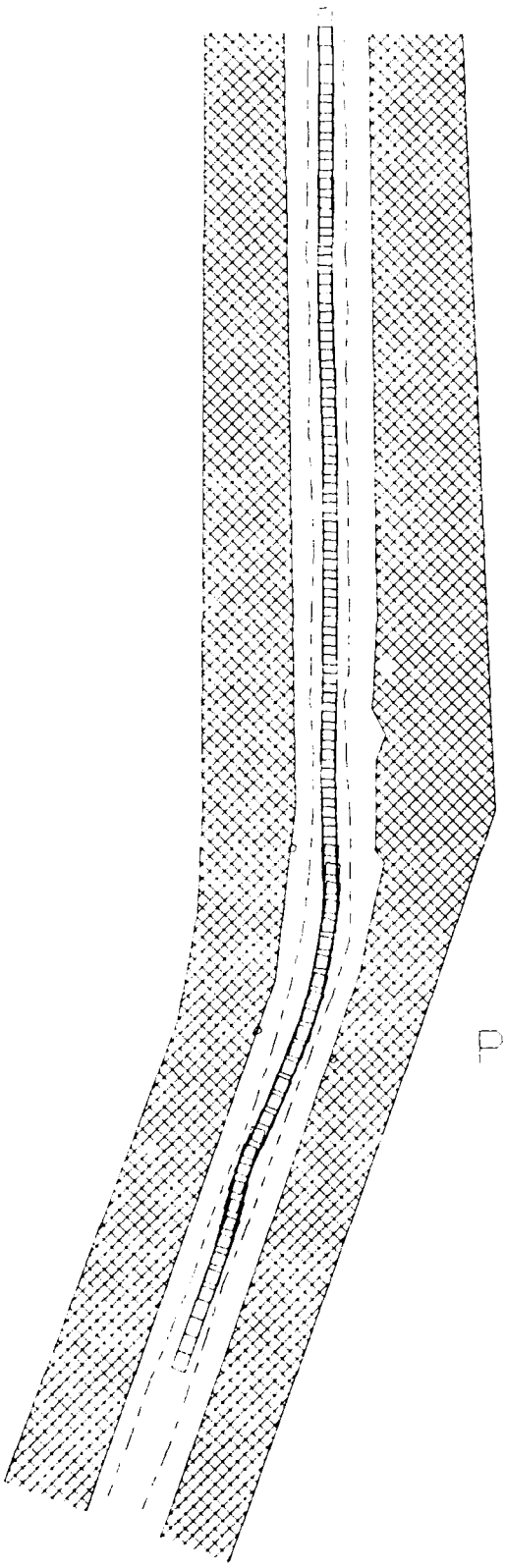
PLATE B143

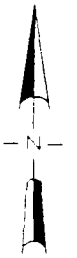


PILOT TRACK PLOTS
AREA C

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 5

PLATE B144





PILOT TRACK PLOT

AREA C

PLAN 1

WITH CURRENT / NO WIND

610 X 93 X 35

RUN 6

PLATE B145

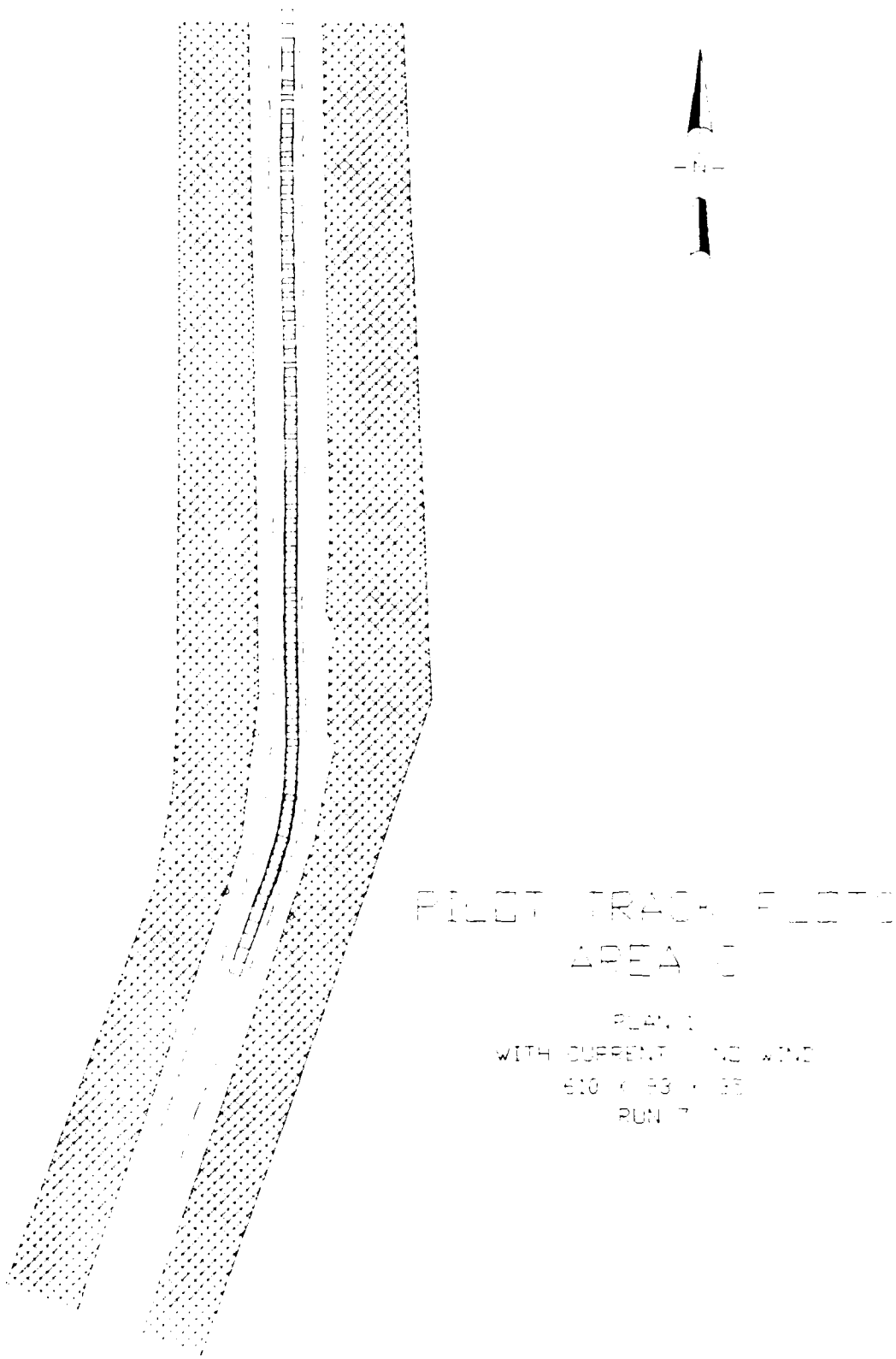
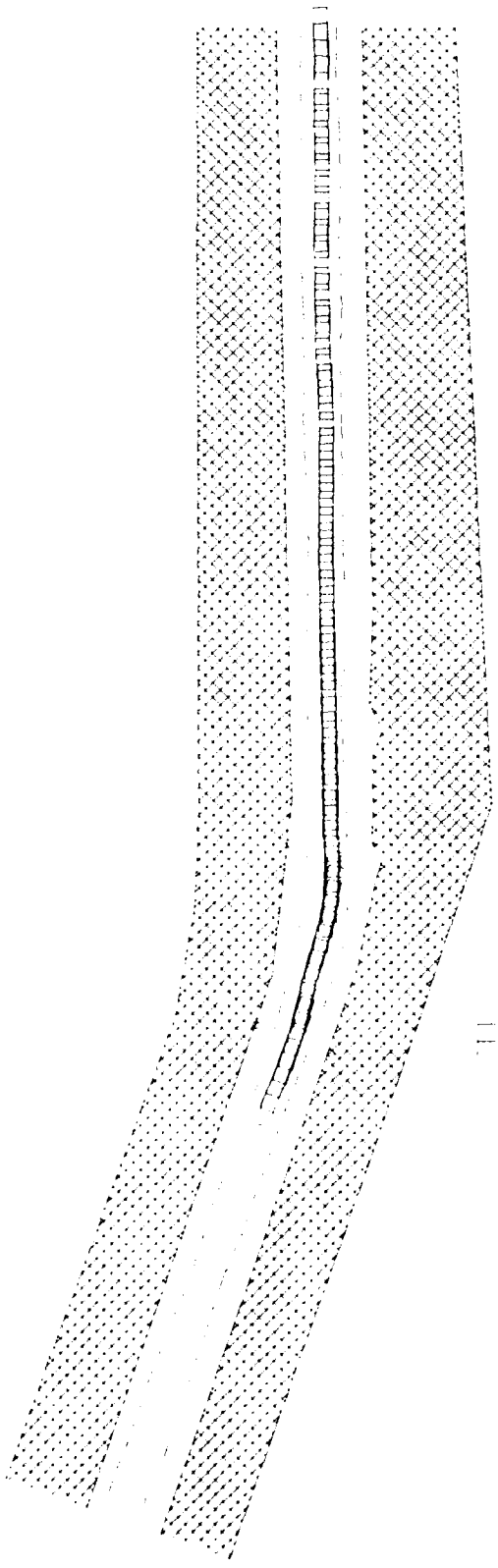
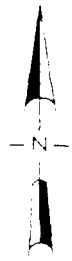


PLATE B146





PLOT TRACK PLOTS

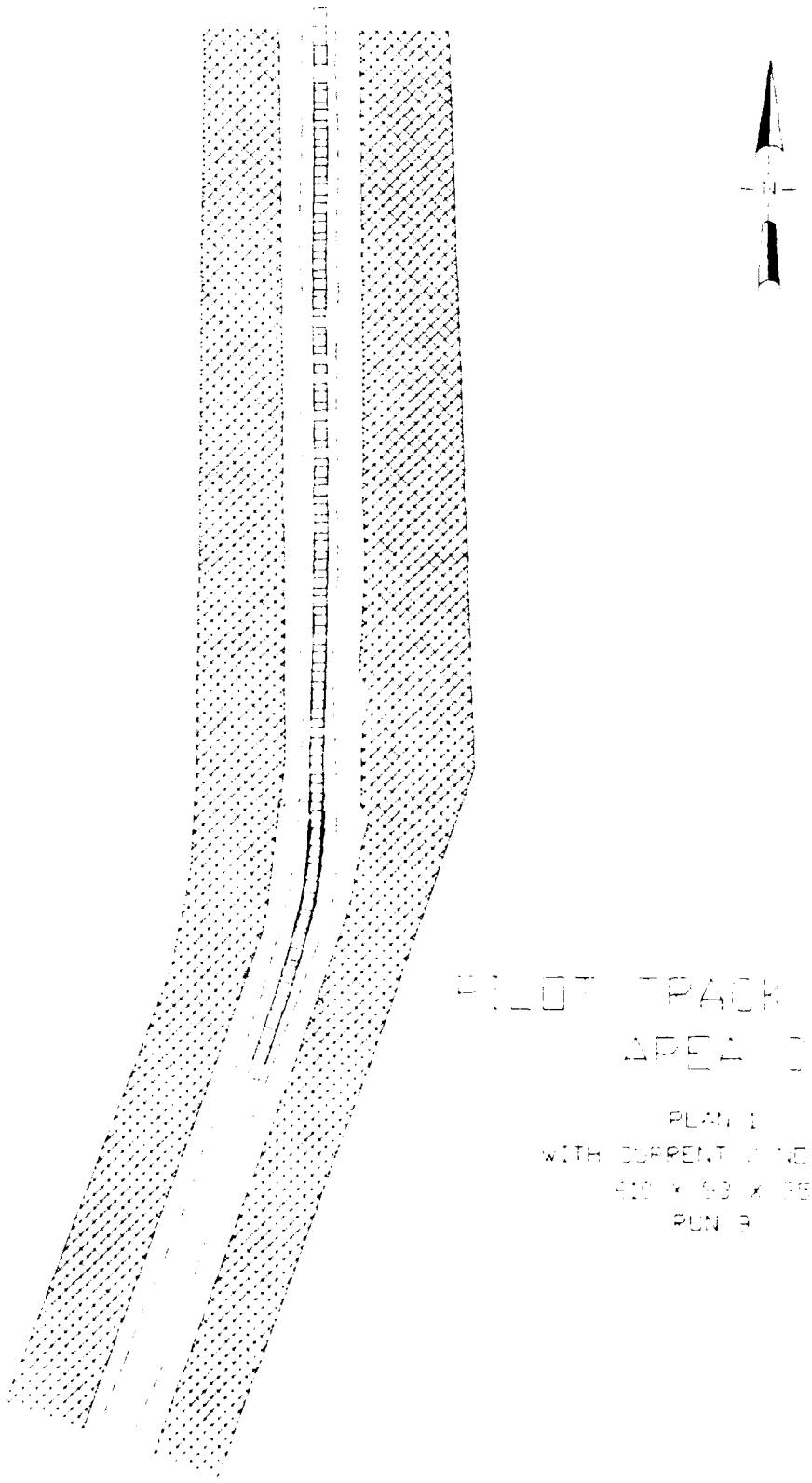
AREA C

PLAN 1

WITH CURRENT [illegible] WIND

610 X 93 X [illegible]

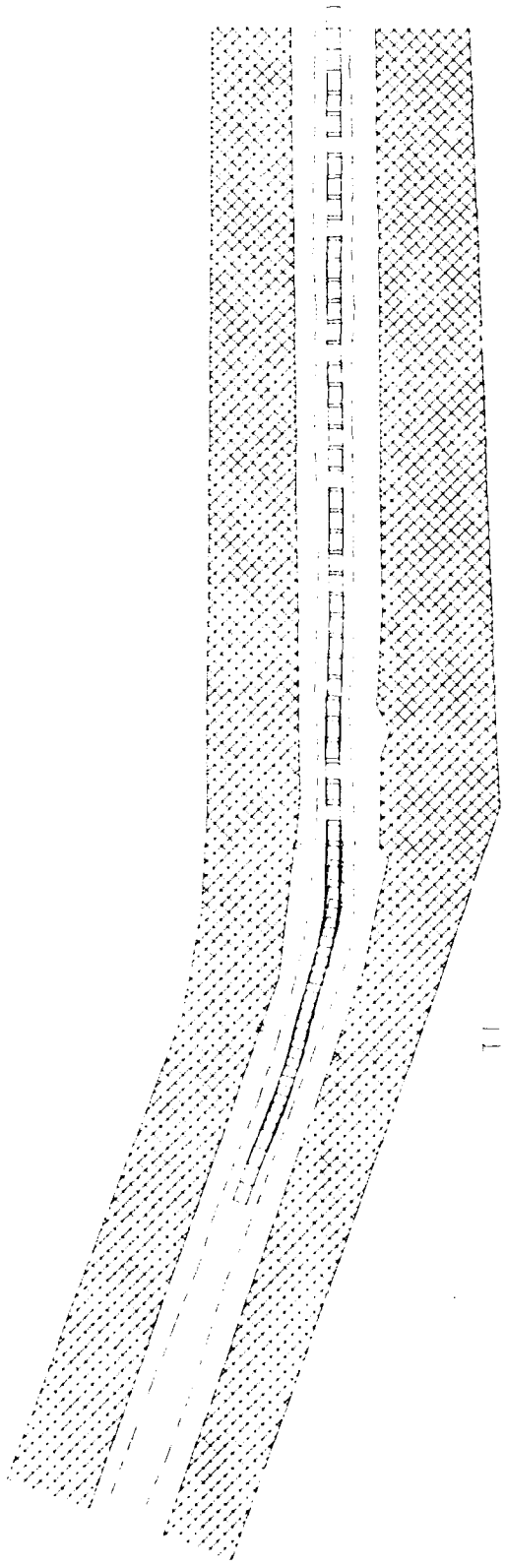
RUN 8

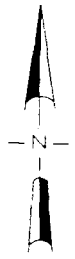


PILOT TRACK PLOT
AREA C

PLAN 1
WITH CURRENT [illegible] WIND
[illegible]
RUN 9

PLATE B148





PILOT TRACK PLOTS

AREA C

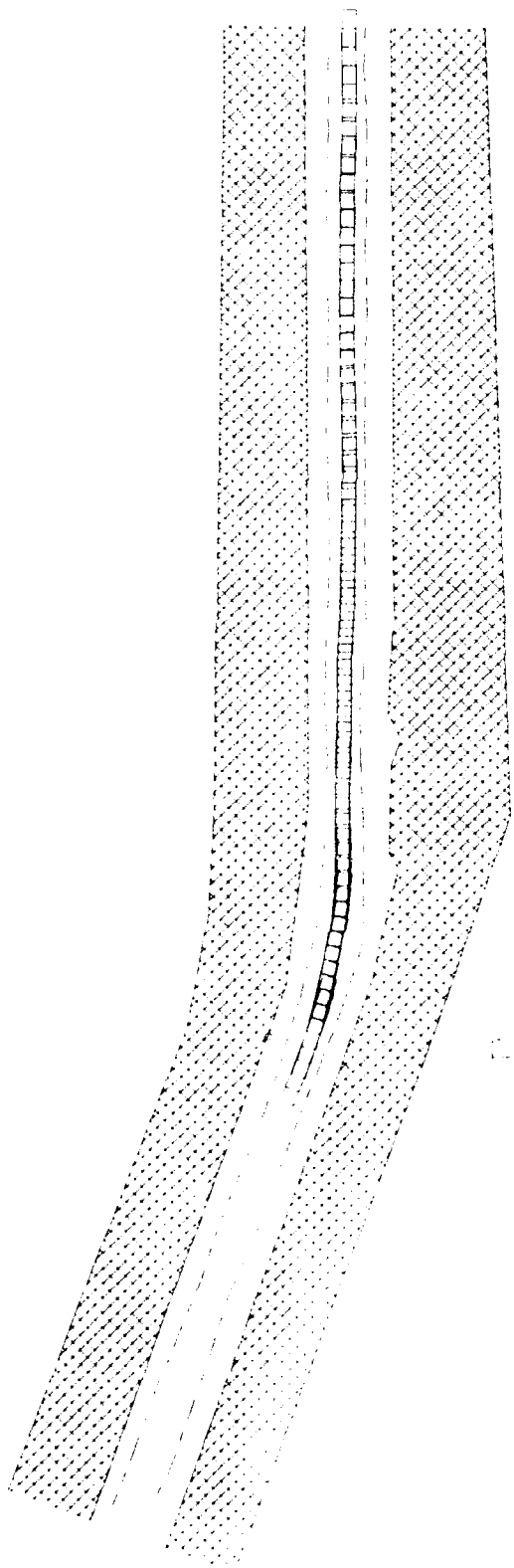
PLAN 1

WITH CURRENT / NS WIND

610 x 93 x 35

RUN 10

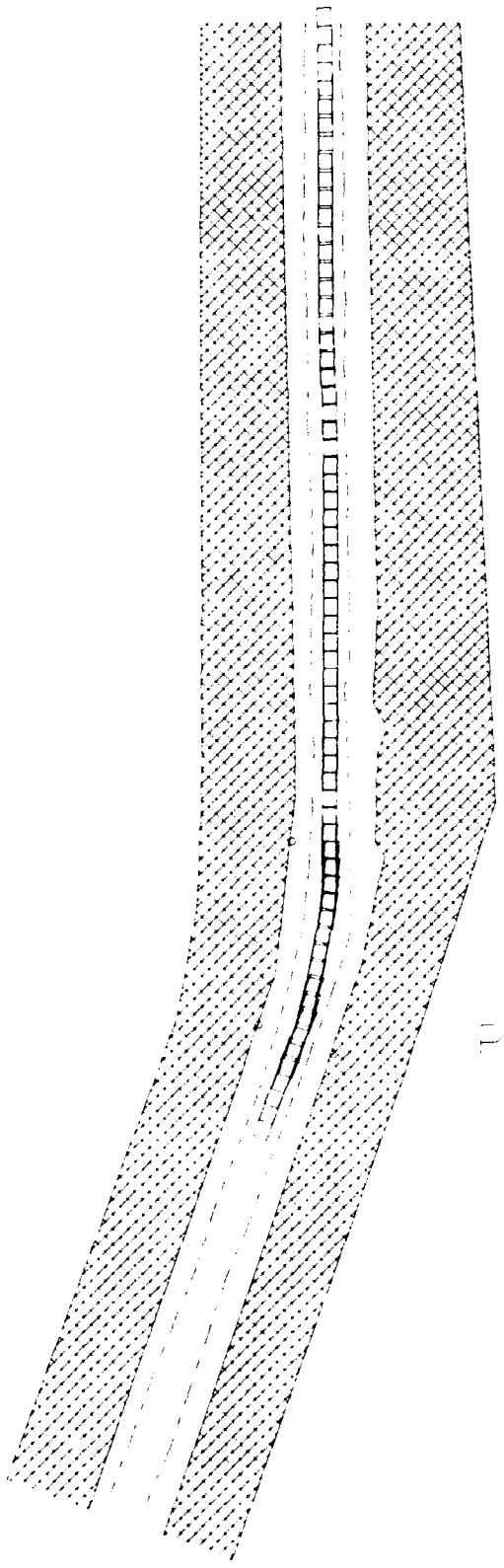
PLATE B149

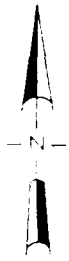


PILOT TRACK PLOT
AREA C

PLAN 1
WITH CURRENT AND WIND
610 X 93 X 35
RUN 11

PLATE B15





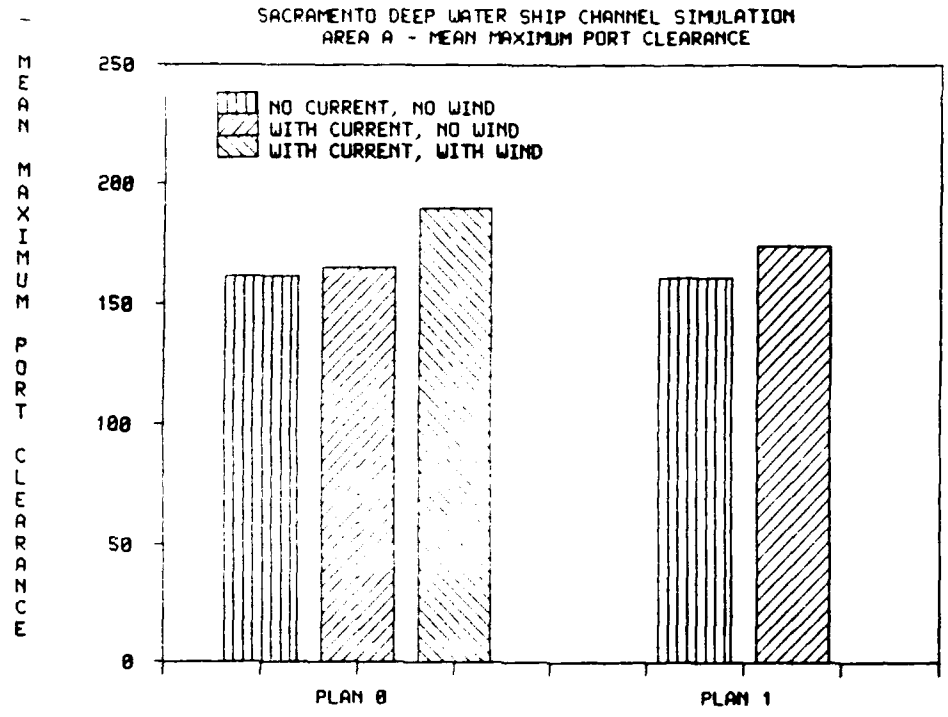
PILOT TRACK PLOT
AREA C

PLAN 1
WITH CURRENT / NO WIND
610 X 93 X 35
RUN 12

PLATE B151

APPENDIX C

STATISTICAL ANALYSIS CHARTS


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN MAXIMUM PORT CLEARANCE
MEAN MAXIMUM PORT CLEARANCE
250
200
150
100
50
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

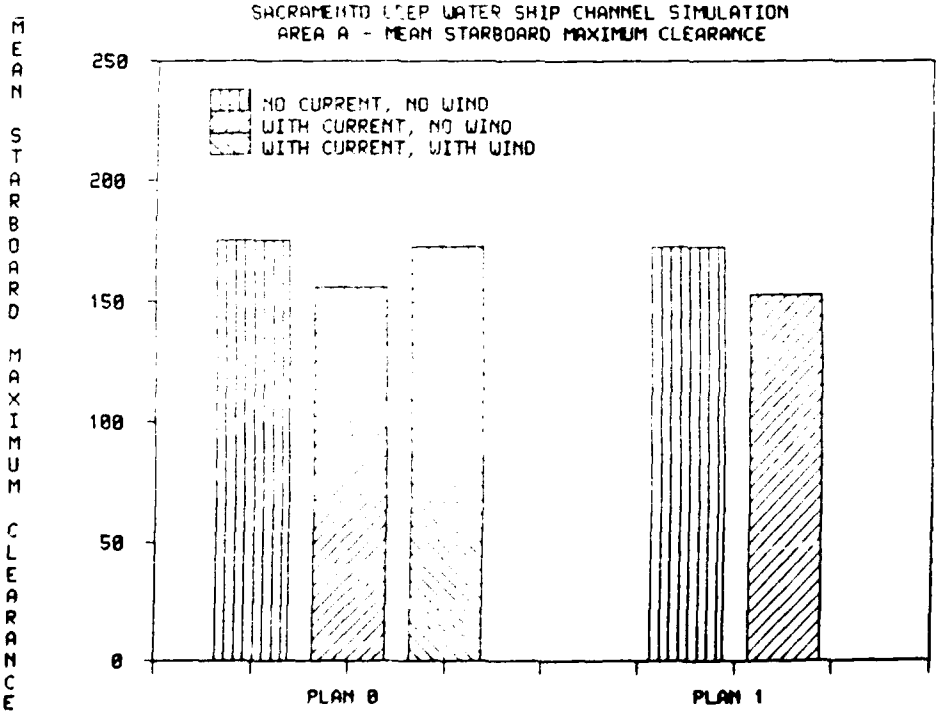

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN STARBOARD MAXIMUM CLEARANCE
MEAN STARBOARD MAXIMUM CLEARANCE
250
200
150
100
50
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

PLATE C1

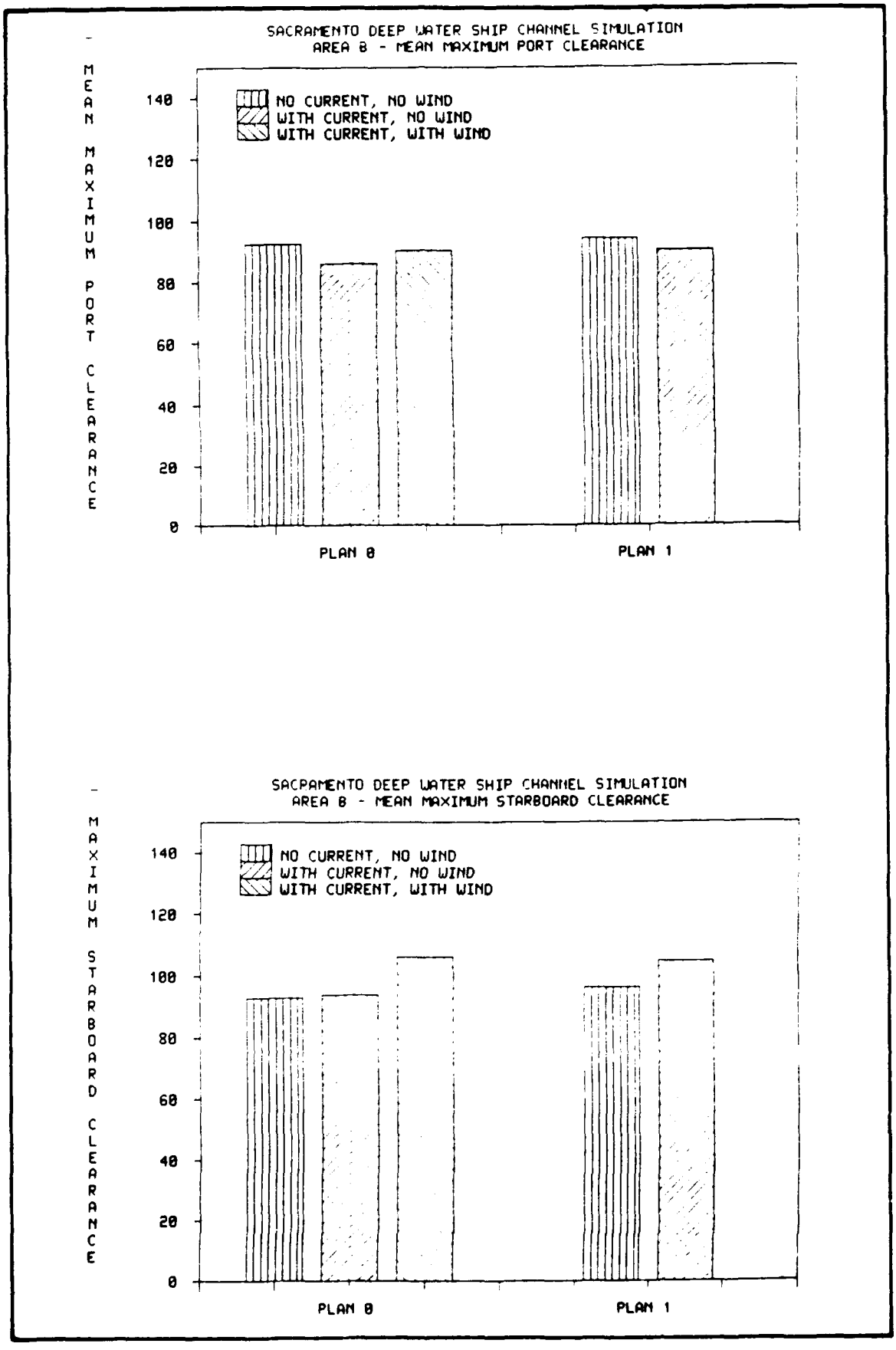
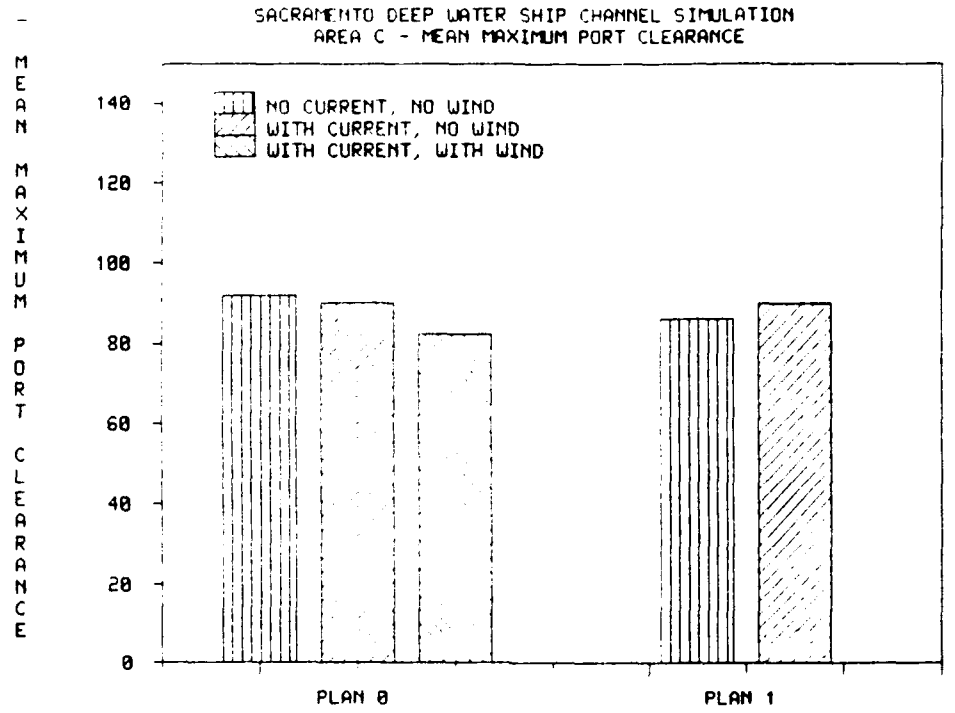

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA 8 - MEAN MAXIMUM PORT CLEARANCE
MEAN MAXIMUM PORT CLEARANCE
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
140
120
100
80
60
40
20
0
PLAN 8
PLAN 1
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA 8 - MEAN MAXIMUM STARBOARD CLEARANCE
MAXIMUM STARBOARD CLEARANCE
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
140
120
100
80
60
40
20
0
PLAN 8
PLAN 1

PLATE C2


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN MAXIMUM PORT CLEARANCE
MEAN MAXIMUM PORT CLEARANCE
140
120
100
80
60
40
20
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

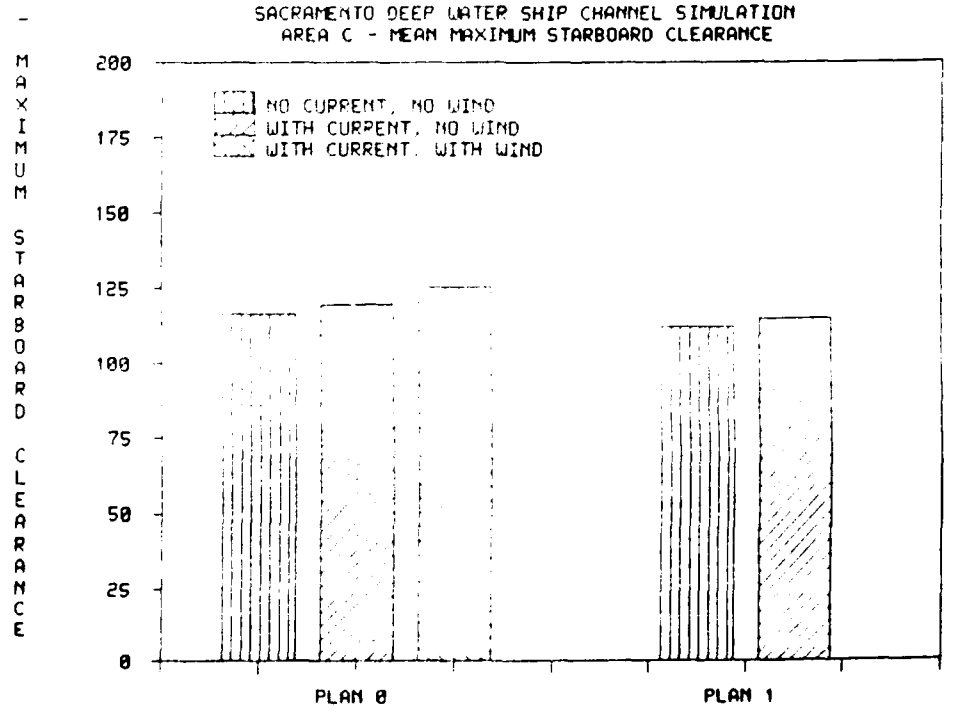

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN MAXIMUM STARBOARD CLEARANCE
MAXIMUM STARBOARD CLEARANCE
200
175
150
125
100
75
50
25
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

PLATE C3

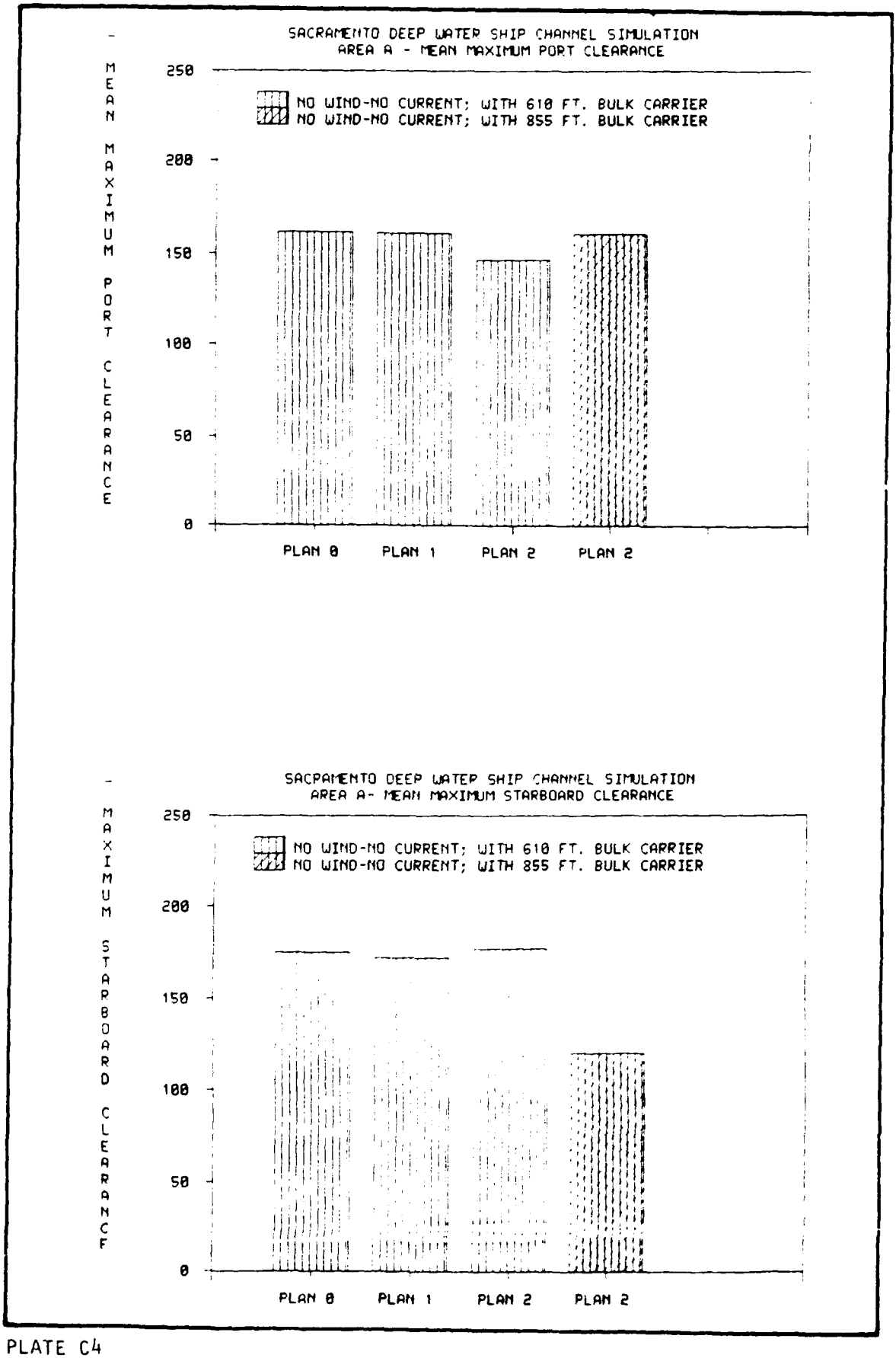
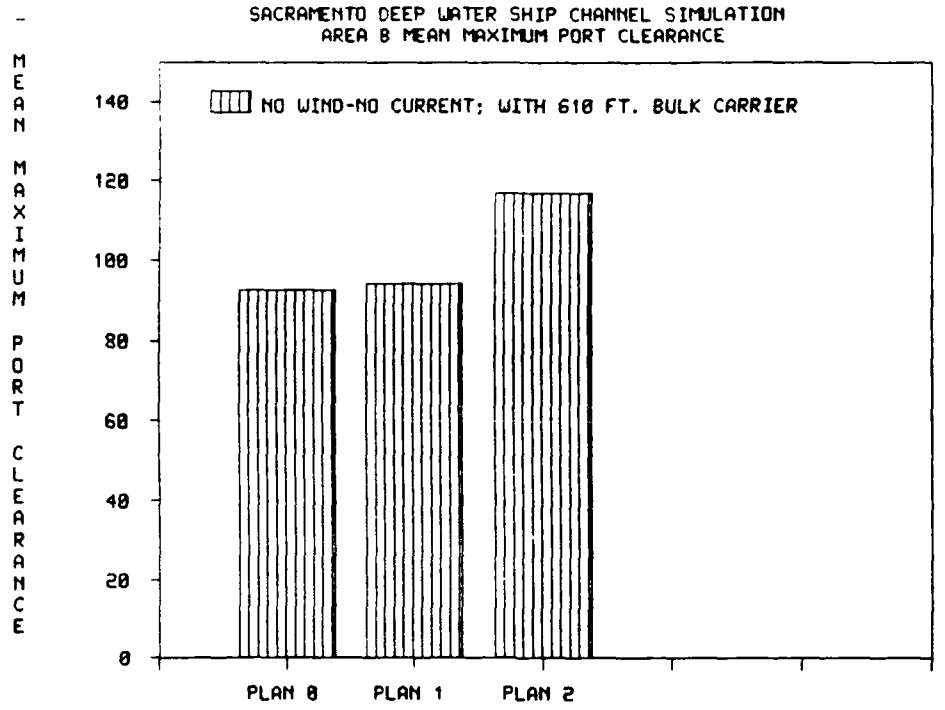

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN MAXIMUM PORT CLEARANCE
MEAN MAXIMUM PORT CLEARANCE
250
200
150
100
50
0
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
PLAN 0
PLAN 1
PLAN 2
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A- MEAN MAXIMUM STARBOARD CLEARANCE
MAXIMUM STARBOARD CLEARANCE
250
200
150
100
50
0
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C4


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA 8 MEAN MAXIMUM PORT CLEARANCE
MEAN MAXIMUM PORT CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2

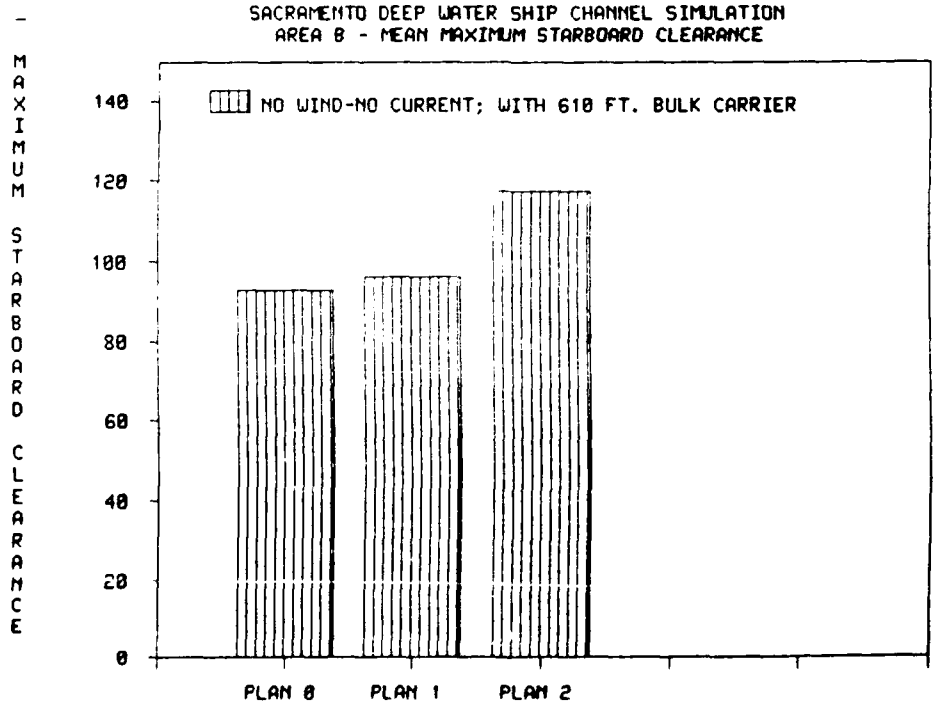
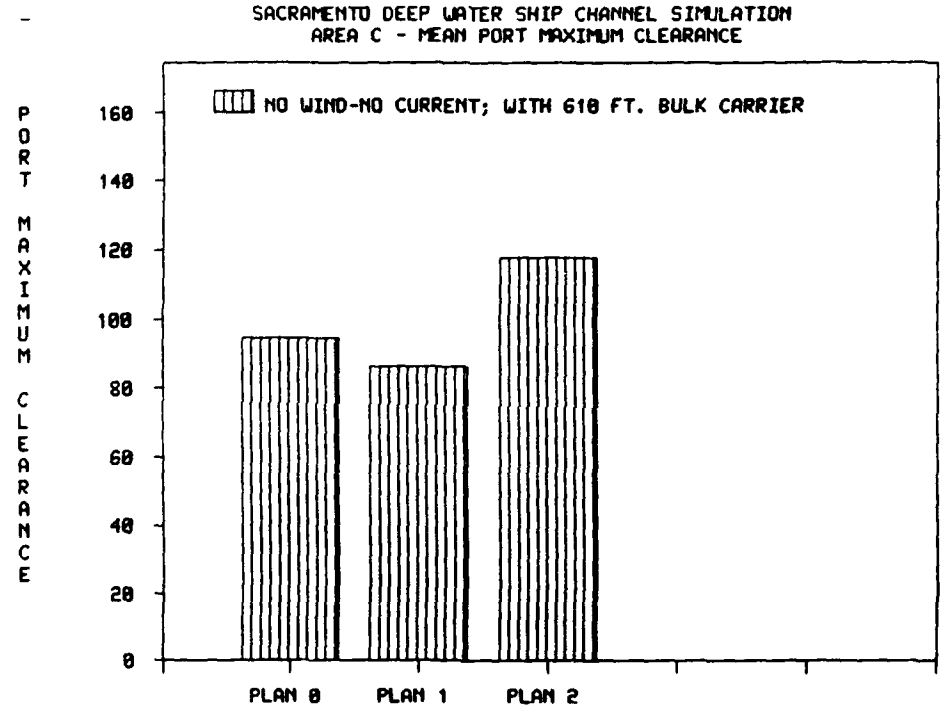

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA 8 - MEAN MAXIMUM STARBOARD CLEARANCE
MAXIMUM STARBOARD CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2

PLATE C5


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN PORT MAXIMUM CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
PORT MAXIMUM CLEARANCE
160
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2

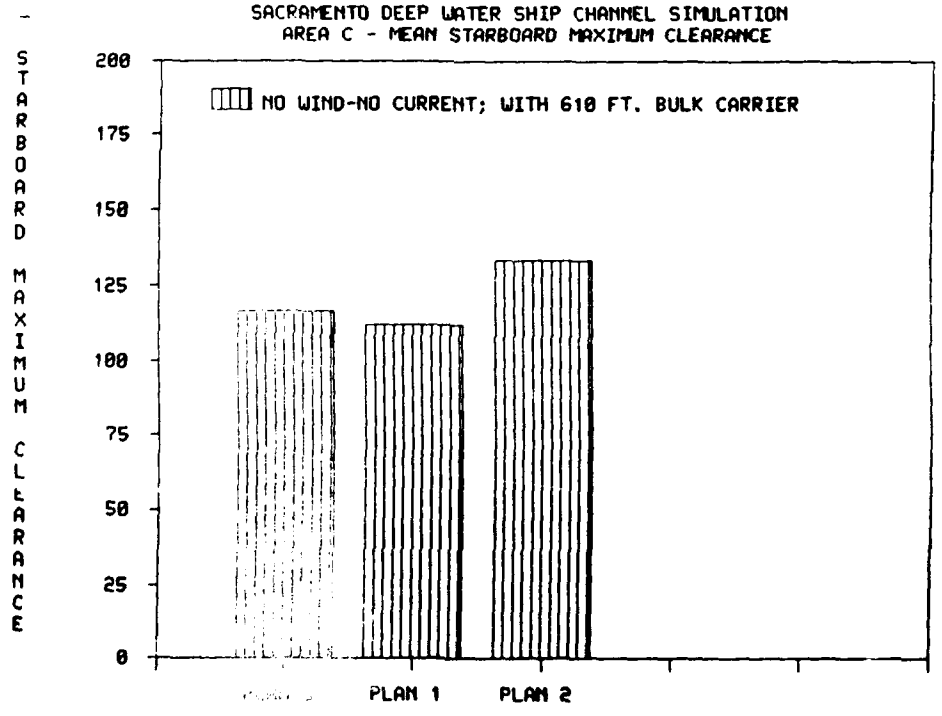
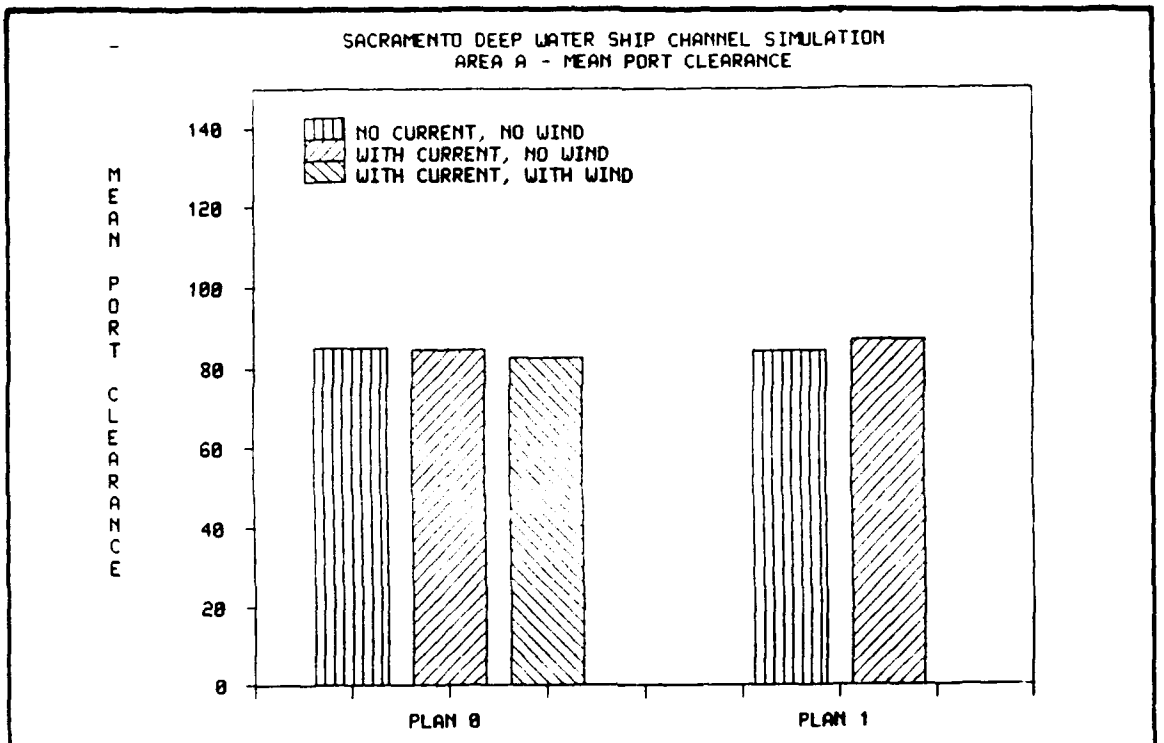

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN STARBOARD MAXIMUM CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STARBOARD MAXIMUM CLEARANCE
200
175
150
125
100
75
50
25
0
PLAN 1
PLAN 2

PLATE C6


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN PORT CLEARANCE
MEAN PORT CLEARANCE
140
120
100
80
60
40
20
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

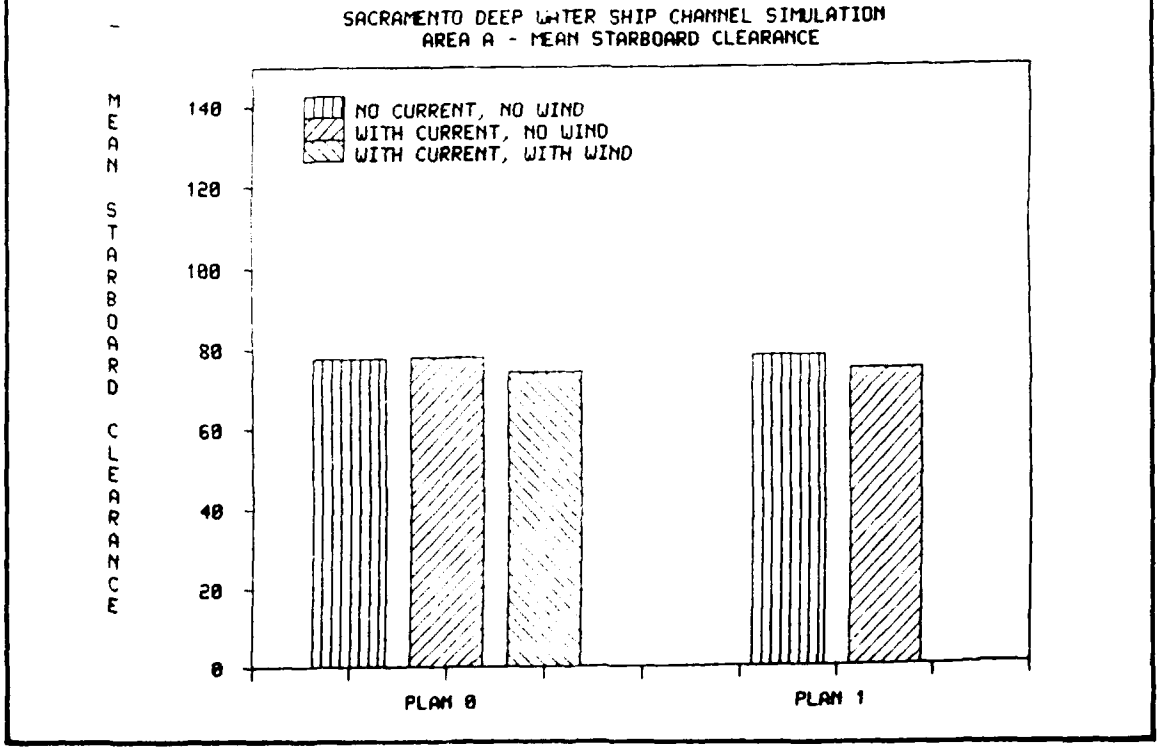

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN STARBOARD CLEARANCE
MEAN STARBOARD CLEARANCE
140
120
100
80
60
40
20
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

PLATE C7

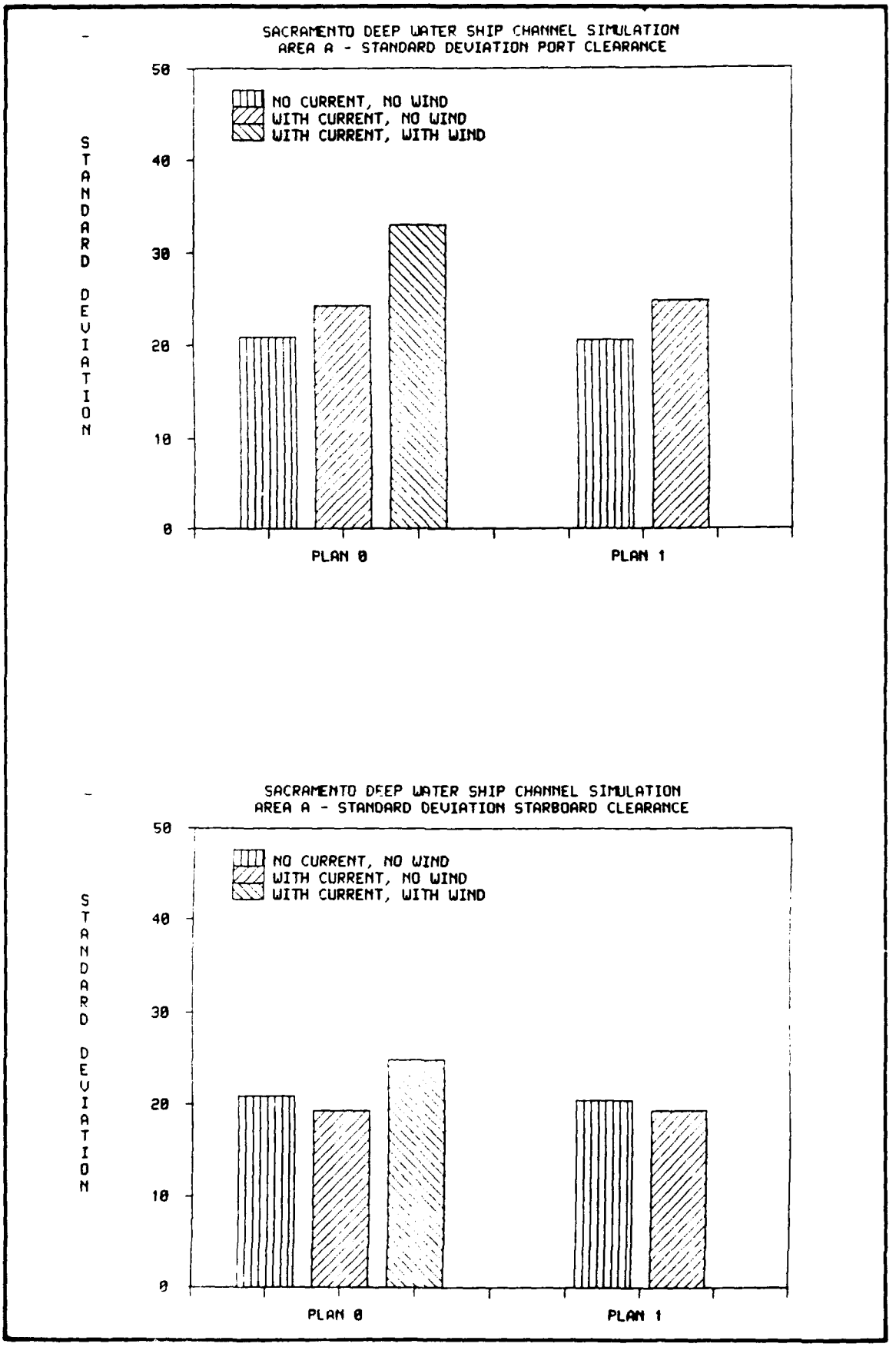
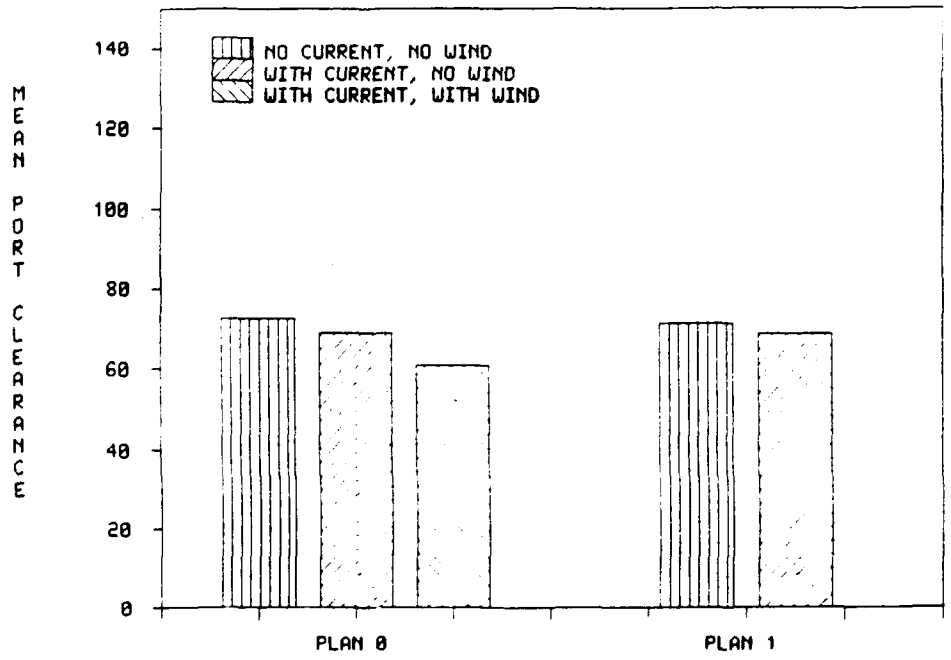

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION PORT CLEARANCE
STANDARD DEVIATION
50
40
30
20
10
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION STARBOARD CLEARANCE
STANDARD DEVIATION
50
40
30
20
10
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

PLATE C8

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - MEAN PORT CLEARANCE



SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - MEAN STARBOARD CLEARANCE

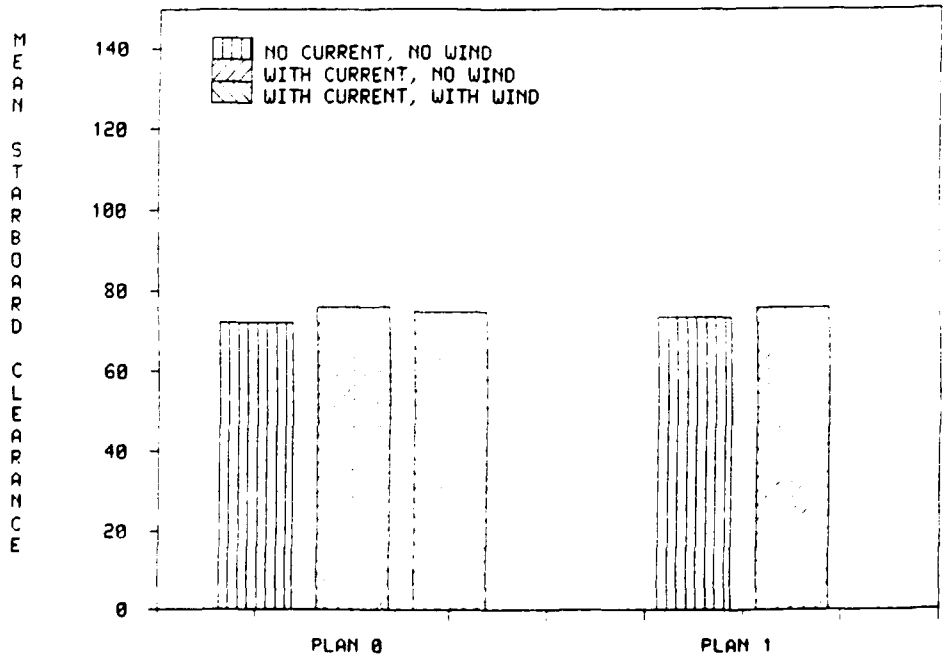
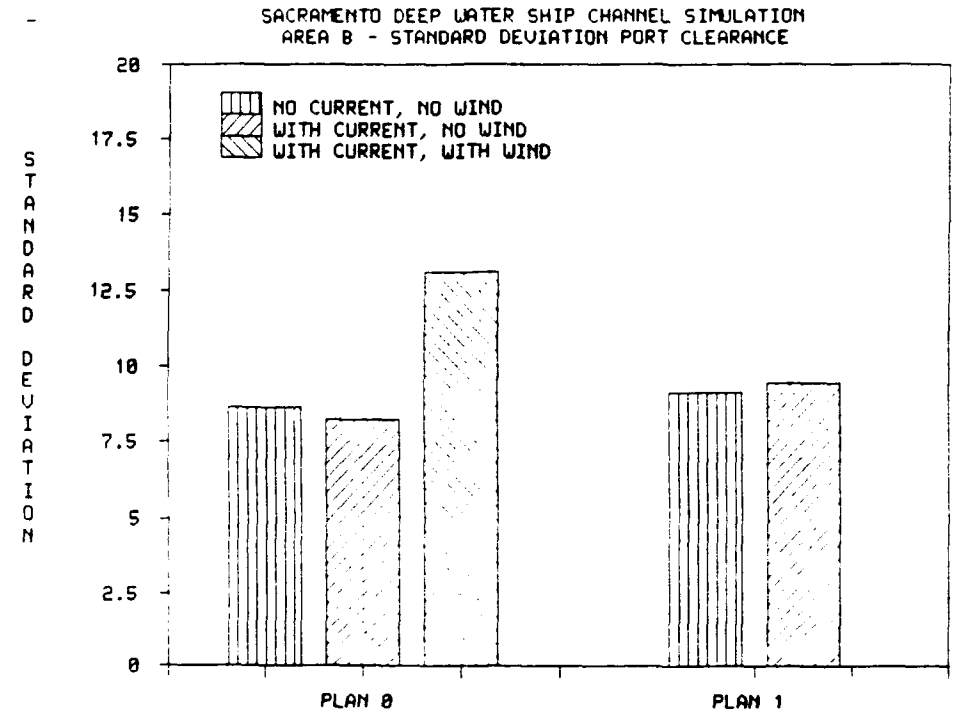


PLATE C9


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - STANDARD DEVIATION PORT CLEARANCE
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
STANDARD DEVIATION
20
17.5
15
12.5
10
7.5
5
2.5
0
PLAN 0
PLAN 1

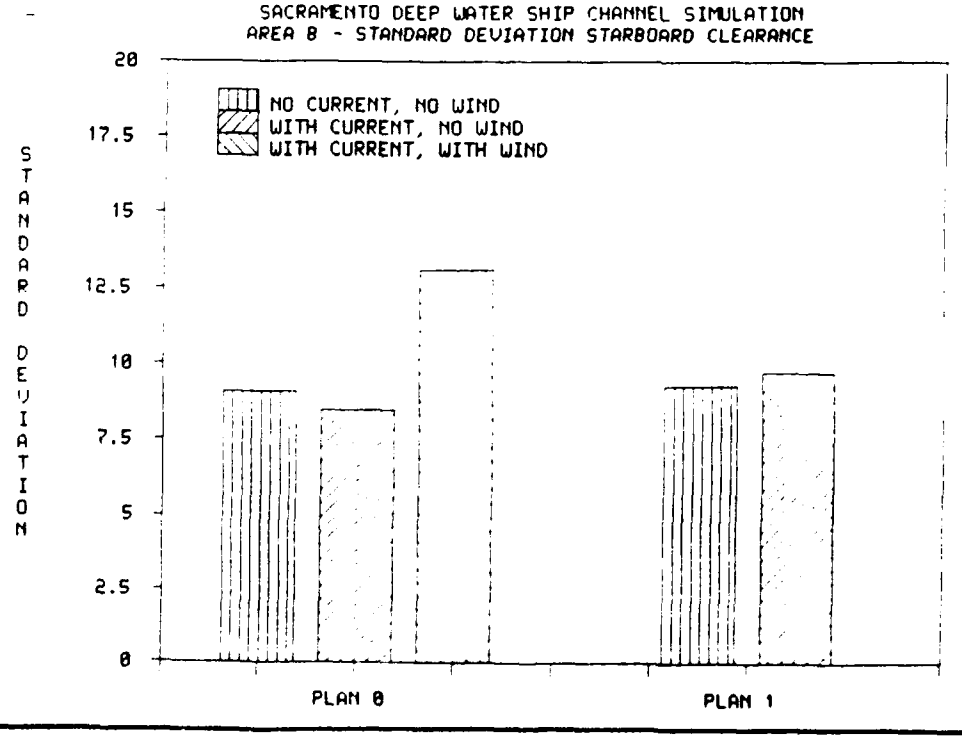
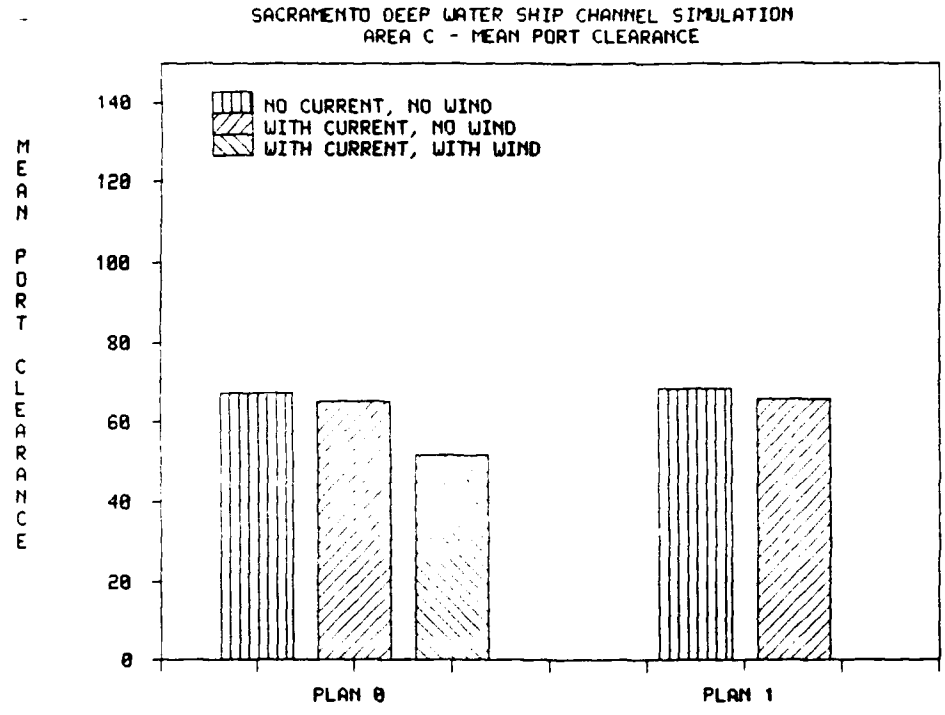

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - STANDARD DEVIATION STARBOARD CLEARANCE
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
STANDARD DEVIATION
20
17.5
15
12.5
10
7.5
5
2.5
0
PLAN 0
PLAN 1

PLATE C10


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN PORT CLEARANCE
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
MEAN PORT CLEARANCE
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1

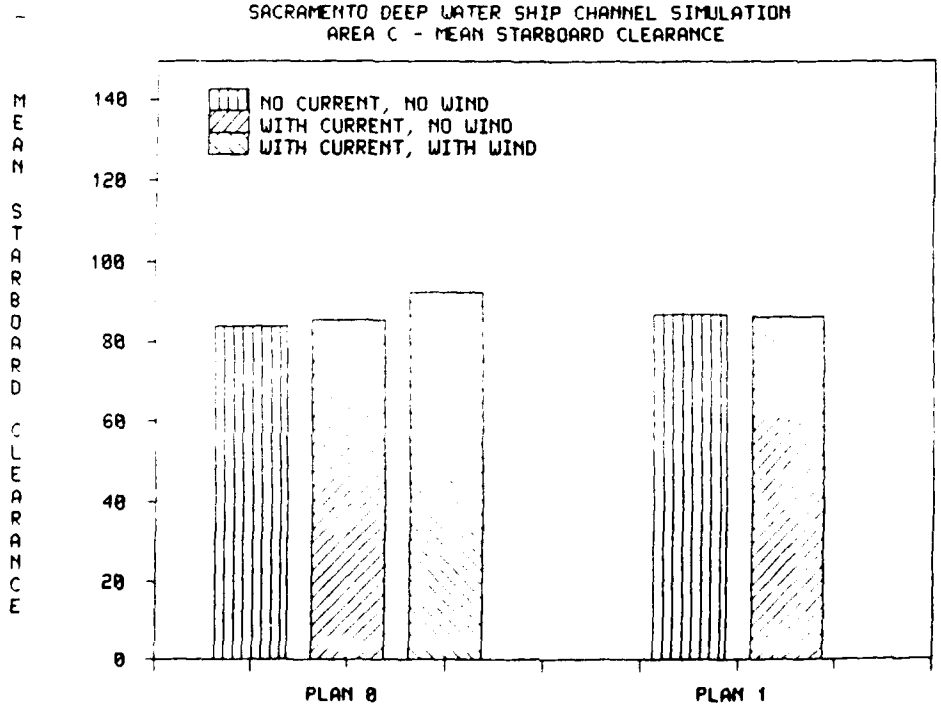
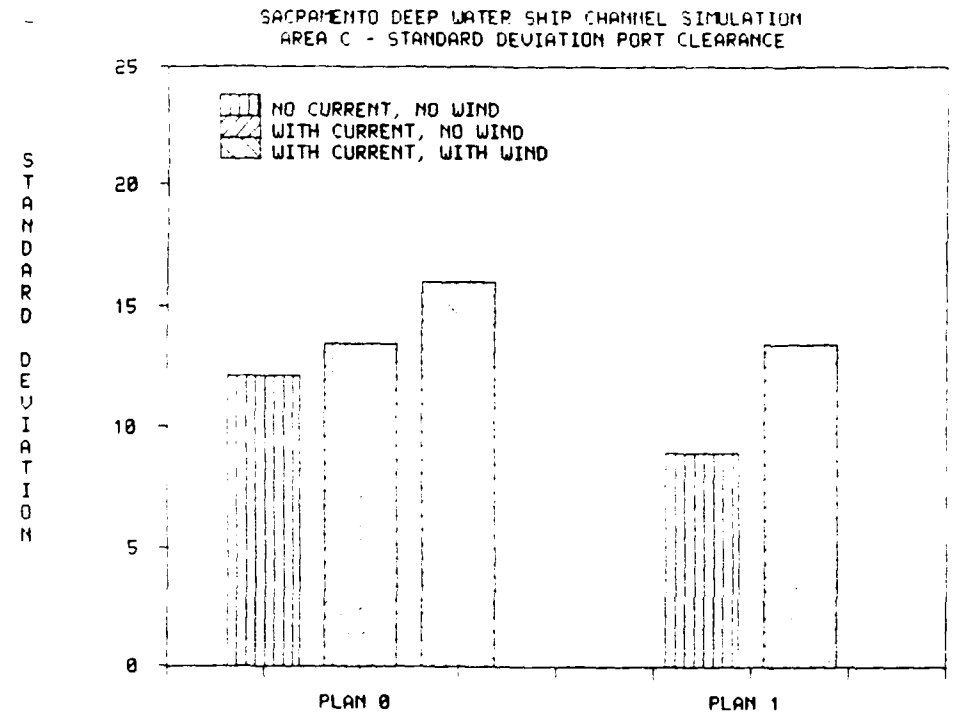

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN STARBOARD CLEARANCE
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
MEAN STARBOARD CLEARANCE
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1

PLATE C11


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION PORT CLEARANCE
STANDARD DEVIATION
25
20
15
10
5
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

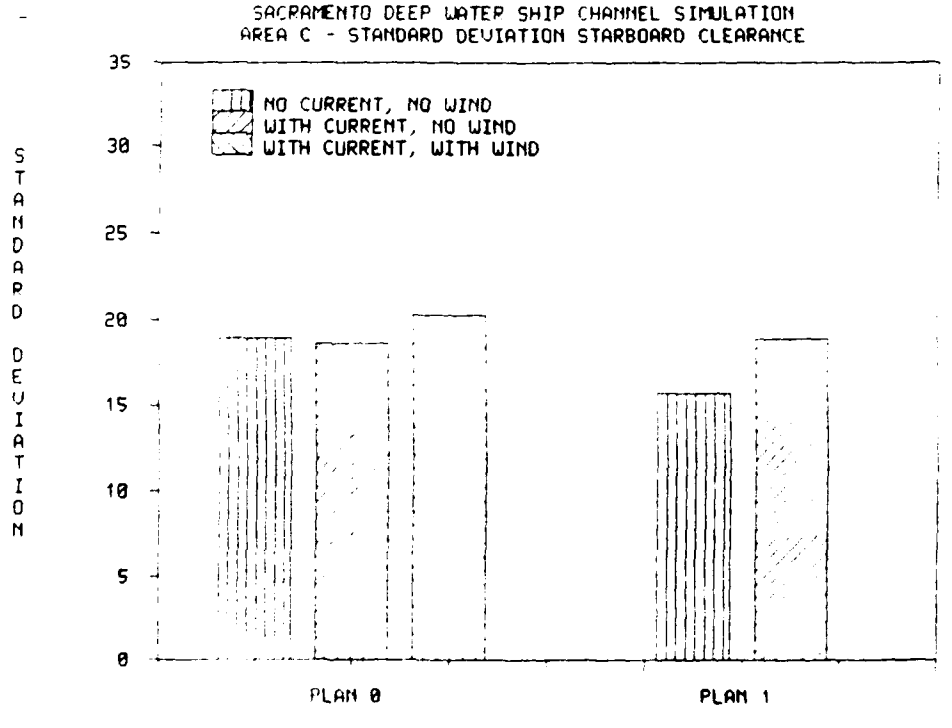
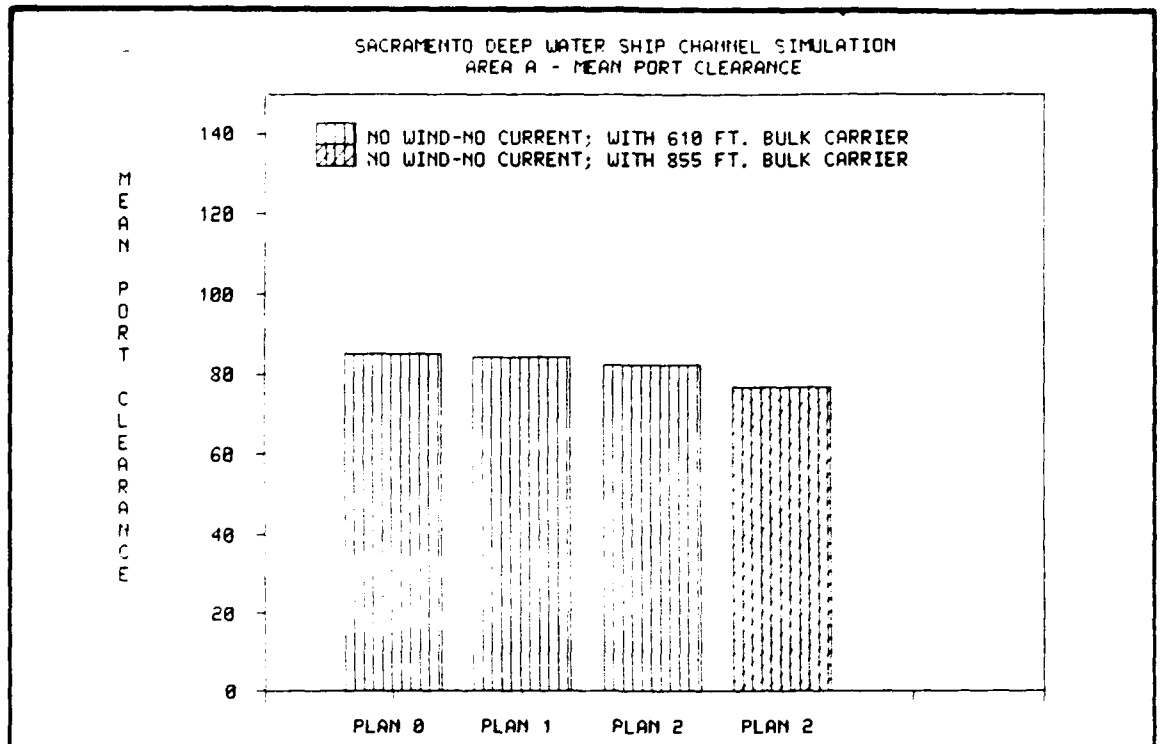

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION STARBOARD CLEARANCE
STANDARD DEVIATION
35
30
25
20
15
10
5
0
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
PLAN 0
PLAN 1

PLATE C12


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN PORT CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN PORT CLEARANCE
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

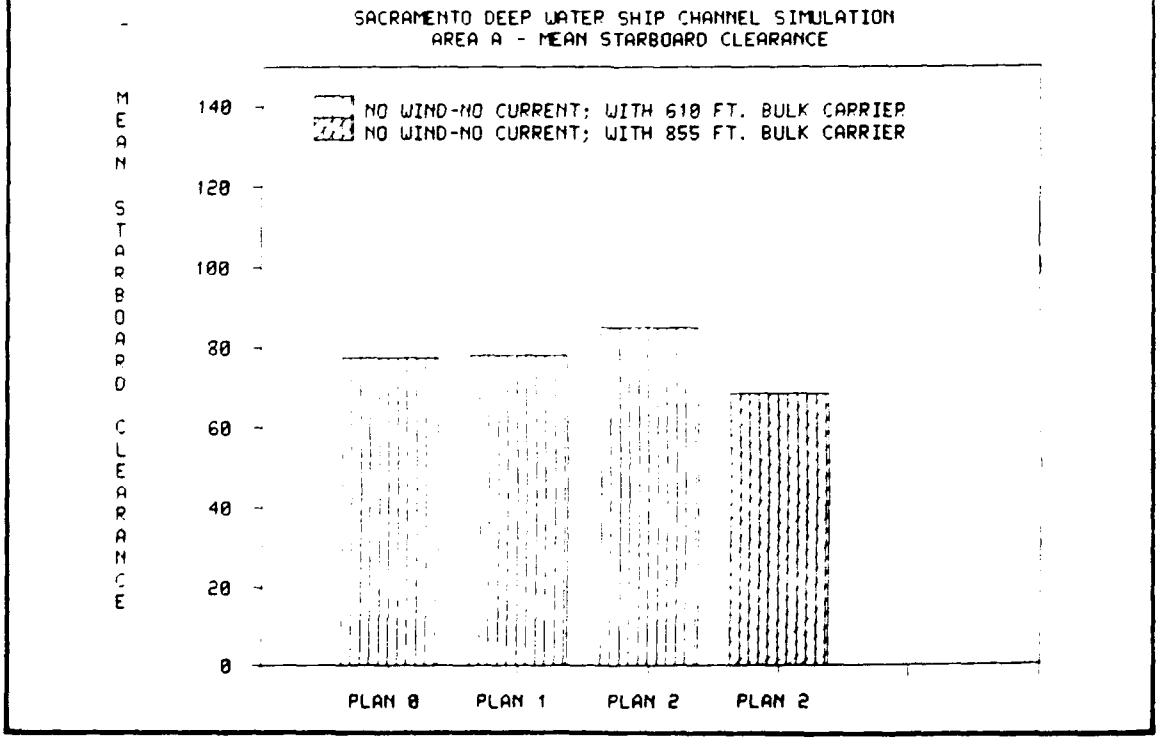

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN STARBOARD CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN STARBOARD CLEARANCE
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C13

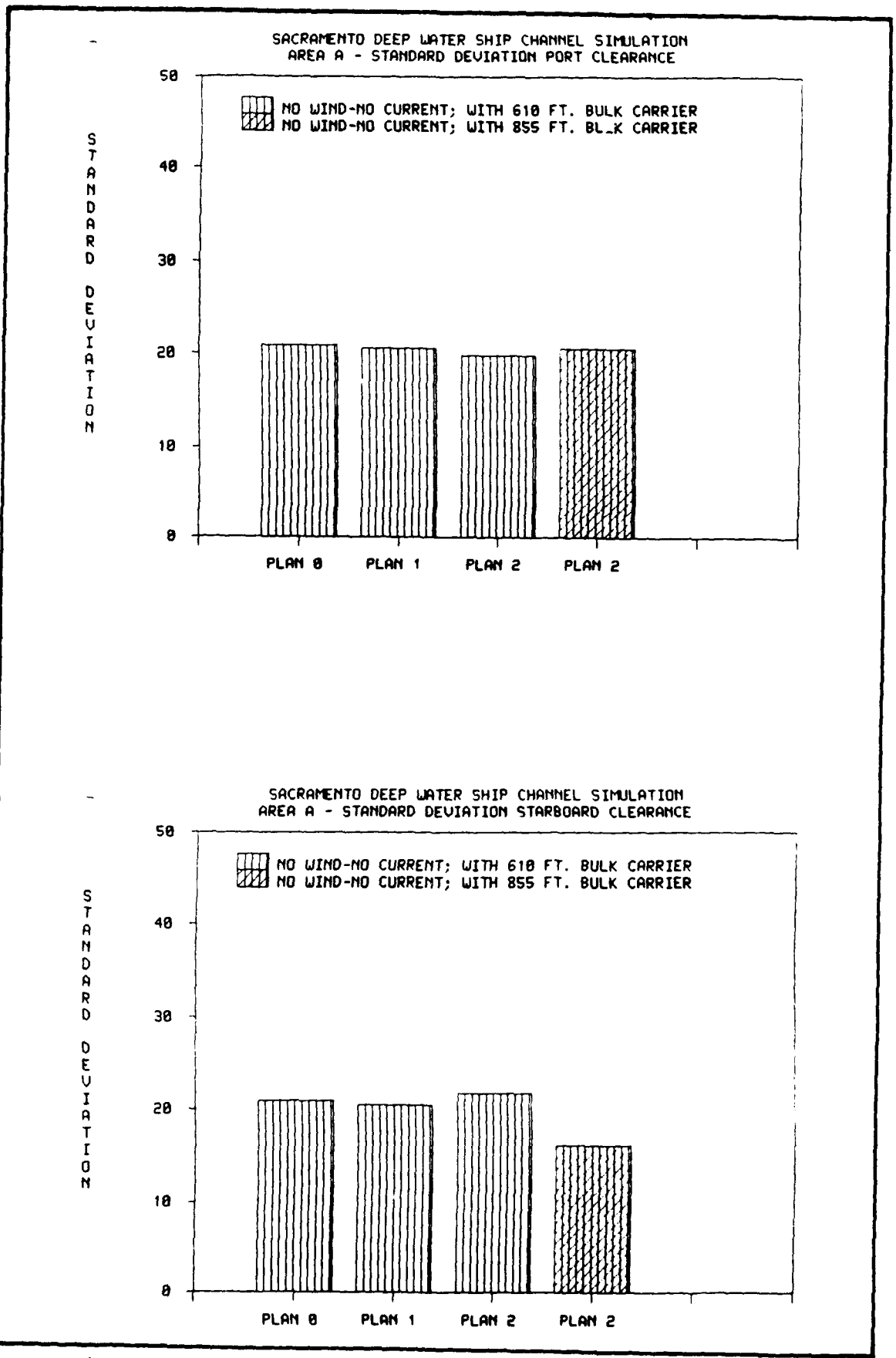
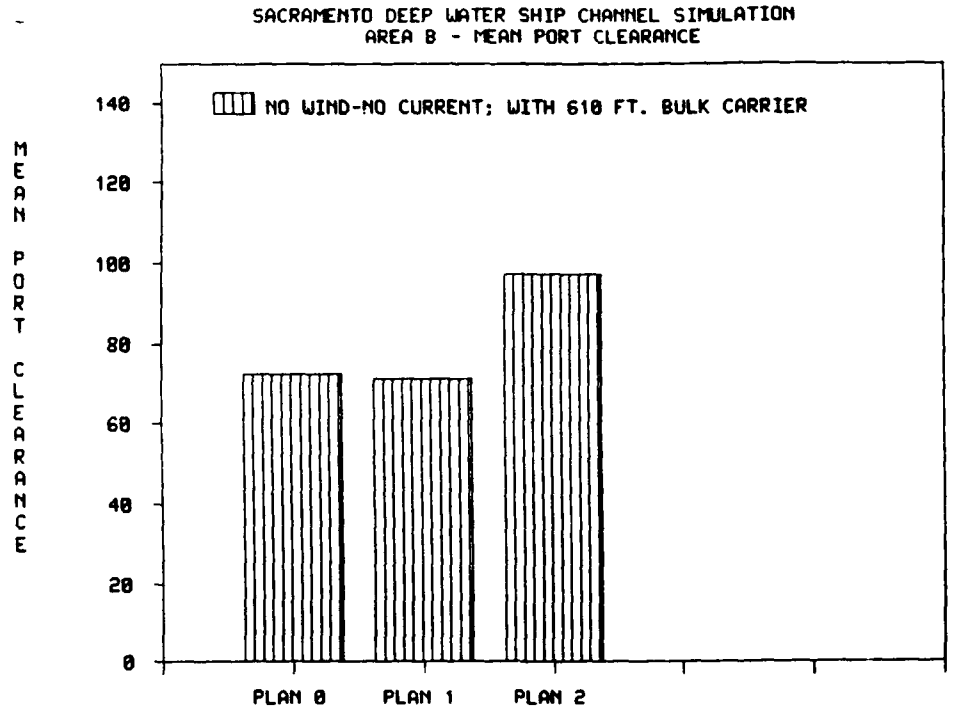

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION PORT CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
STANDARD DEVIATION
50
40
30
20
10
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION STARBOARD CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
STANDARD DEVIATION
50
40
30
20
10
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C14


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - MEAN PORT CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
MEAN PORT CLEARANCE
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2

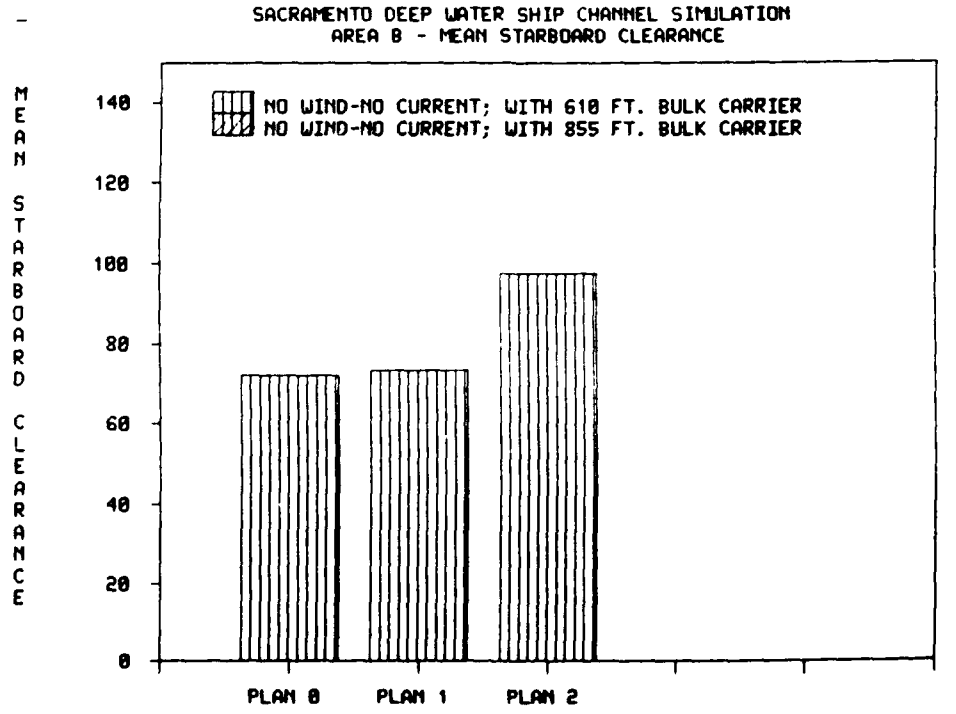
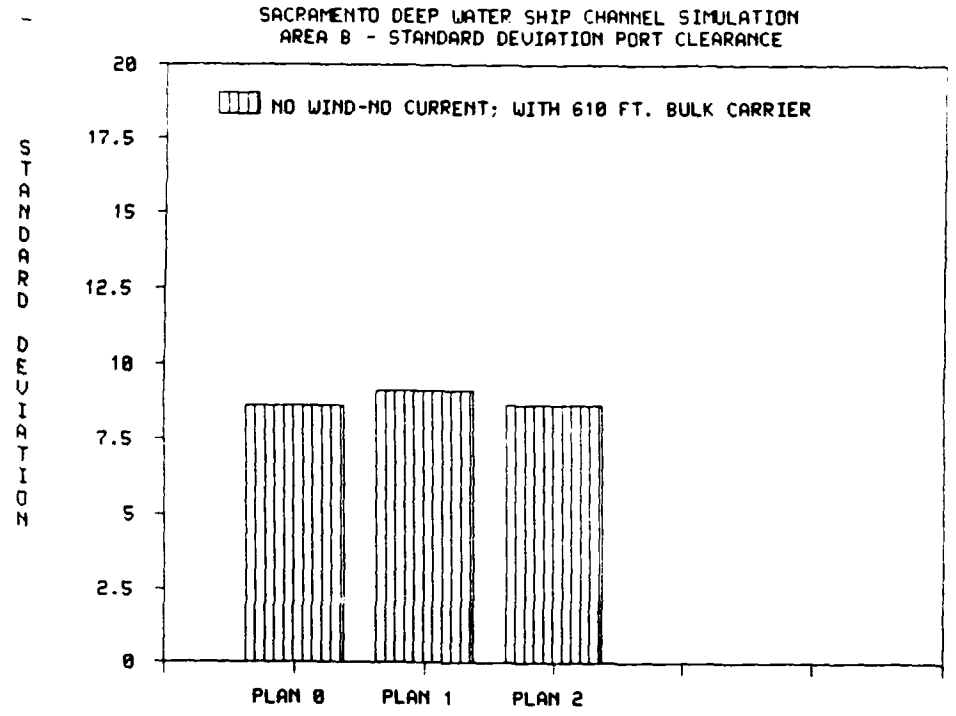

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - MEAN STARBOARD CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN STARBOARD CLEARANCE
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2

PLATE C15


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - STANDARD DEVIATION PORT CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
20
17.5
15
12.5
10
7.5
5
2.5
0
PLAN 0
PLAN 1
PLAN 2

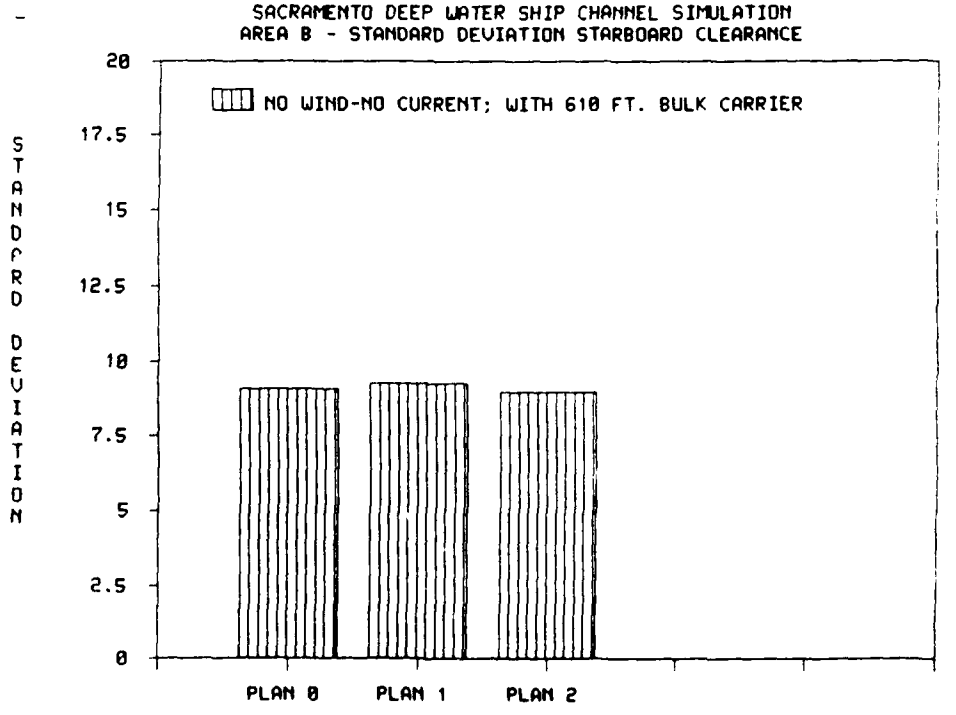
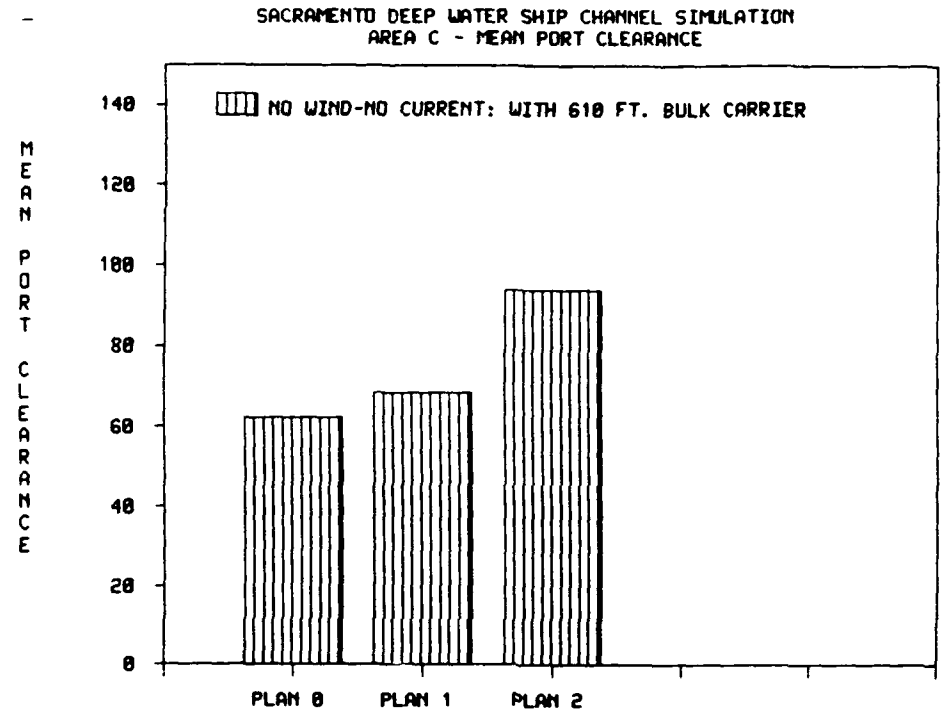

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - STANDARD DEVIATION STARBOARD CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
20
17.5
15
12.5
10
7.5
5
2.5
0
PLAN 0
PLAN 1
PLAN 2

PLATE C16


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN PORT CLEARANCE
NO WIND-NO CURRENT: WITH 610 FT. BULK CARRIER
MEAN PORT CLEARANCE
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2

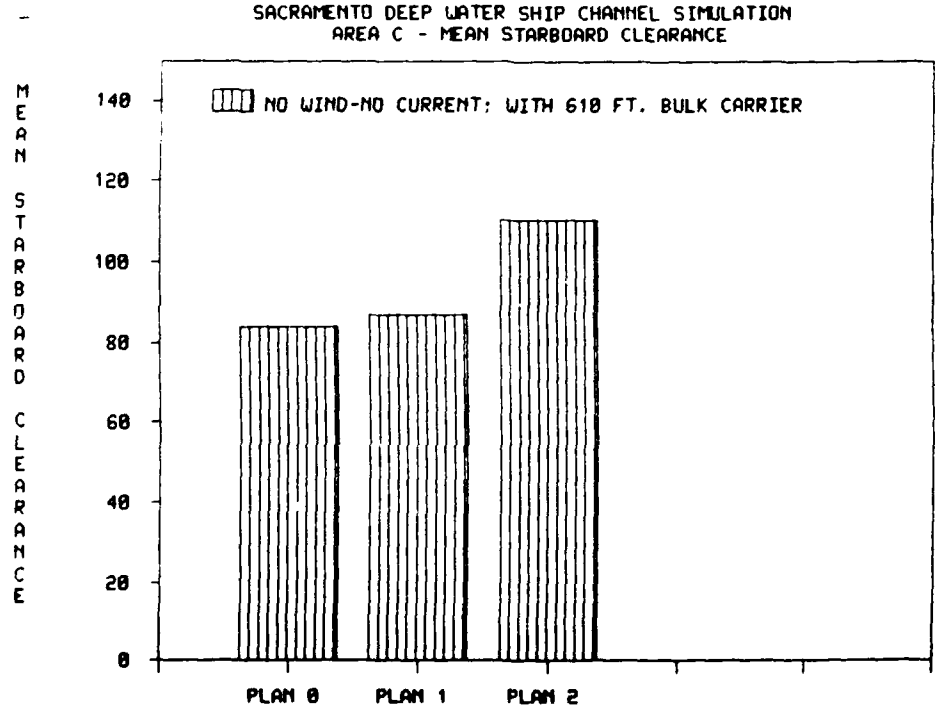

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN STARBOARD CLEARANCE
NO WIND-NO CURRENT: WITH 610 FT. BULK CARRIER
MEAN STARBOARD CLEARANCE
140
120
100
80
60
40
20
0
PLAN 0
PLAN 1
PLAN 2

PLATE C17

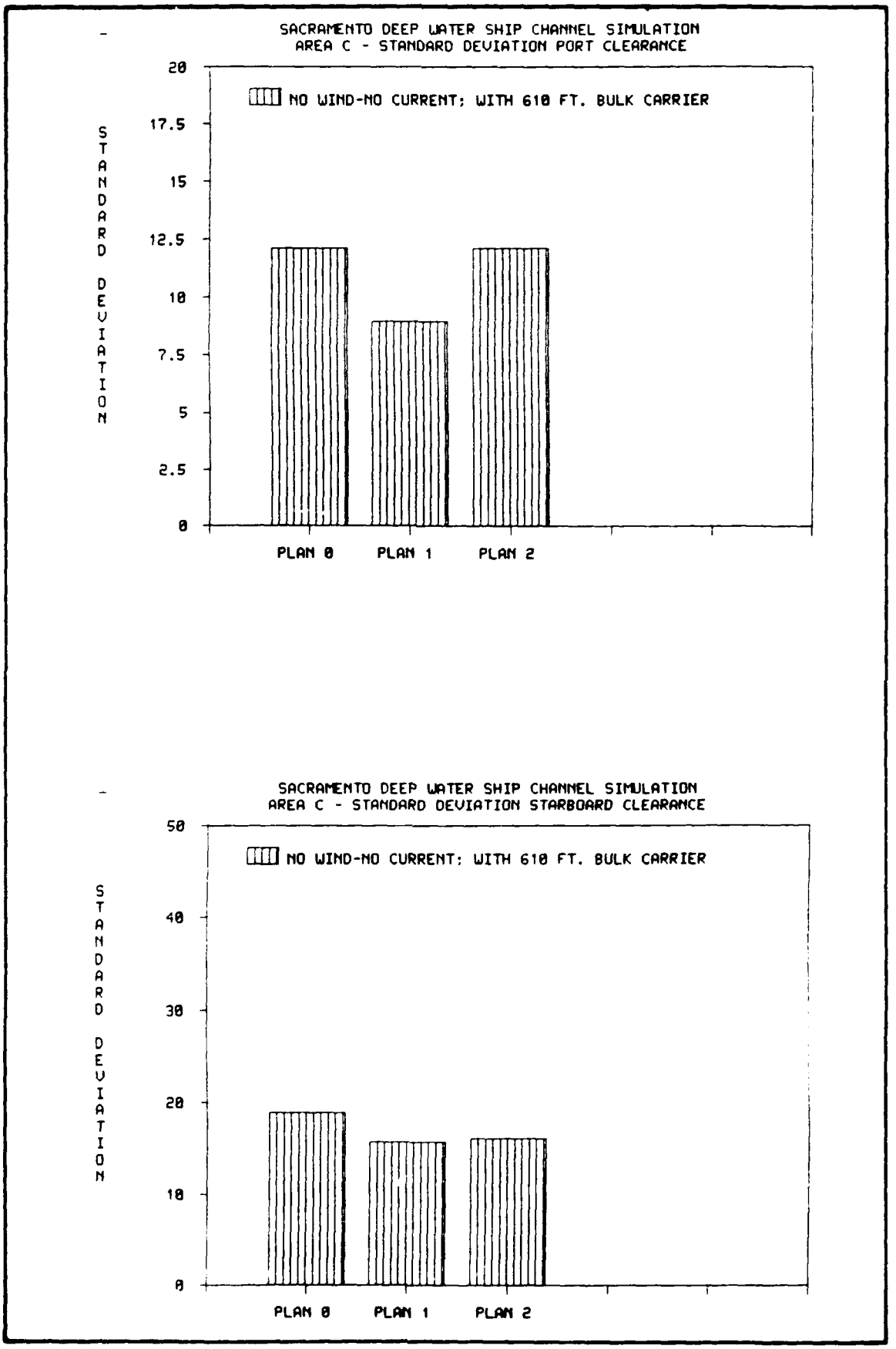
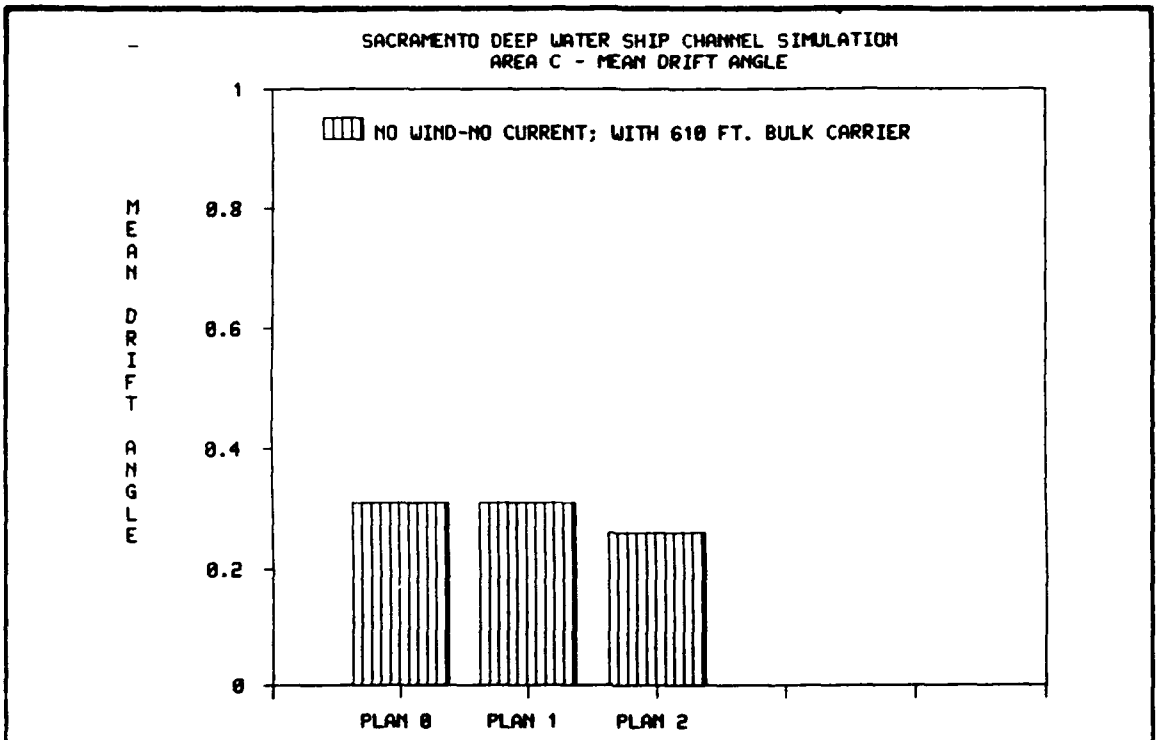

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION PORT CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
20
17.5
15
12.5
10
7.5
5
2.5
0
PLAN 0
PLAN 1
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION STARBOARD CLEARANCE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
50
40
30
20
10
0
PLAN 0
PLAN 1
PLAN 2

PLATE C18


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN DRIFT ANGLE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
MEAN DRIFT ANGLE
1
0.8
0.6
0.4
0.2
0
PLAN 0
PLAN 1
PLAN 2

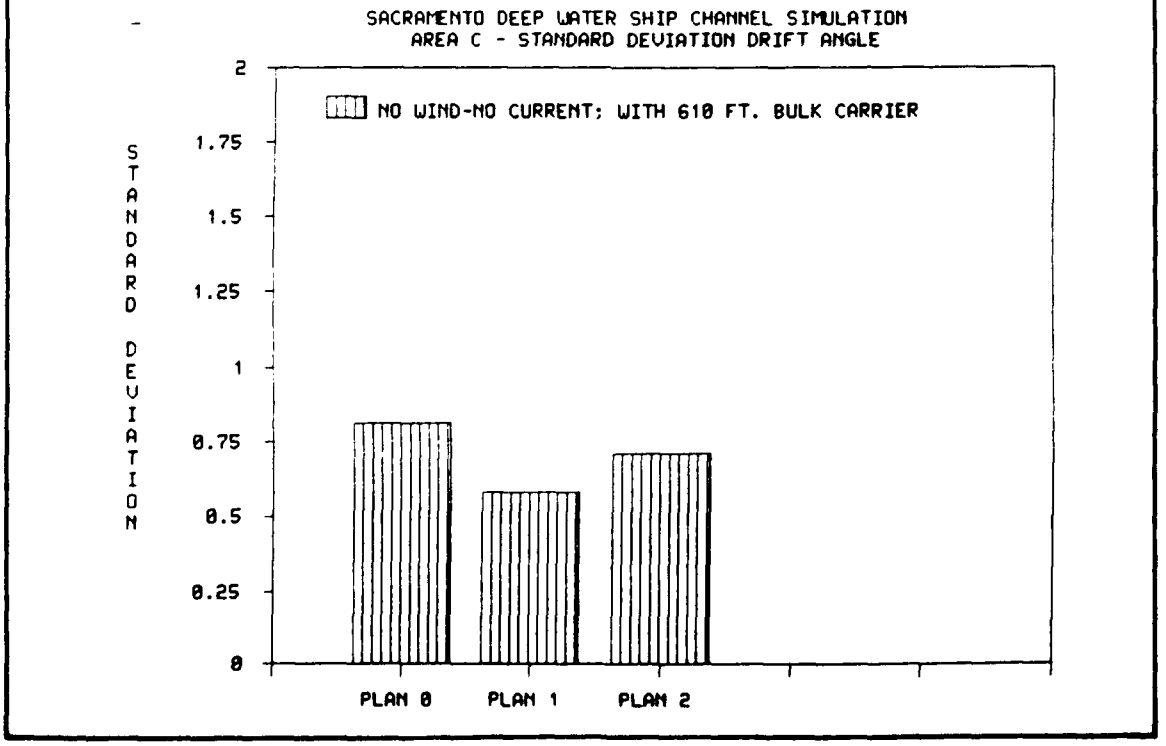

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION DRIFT ANGLE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
PLAN 0
PLAN 1
PLAN 2

PLATE C19

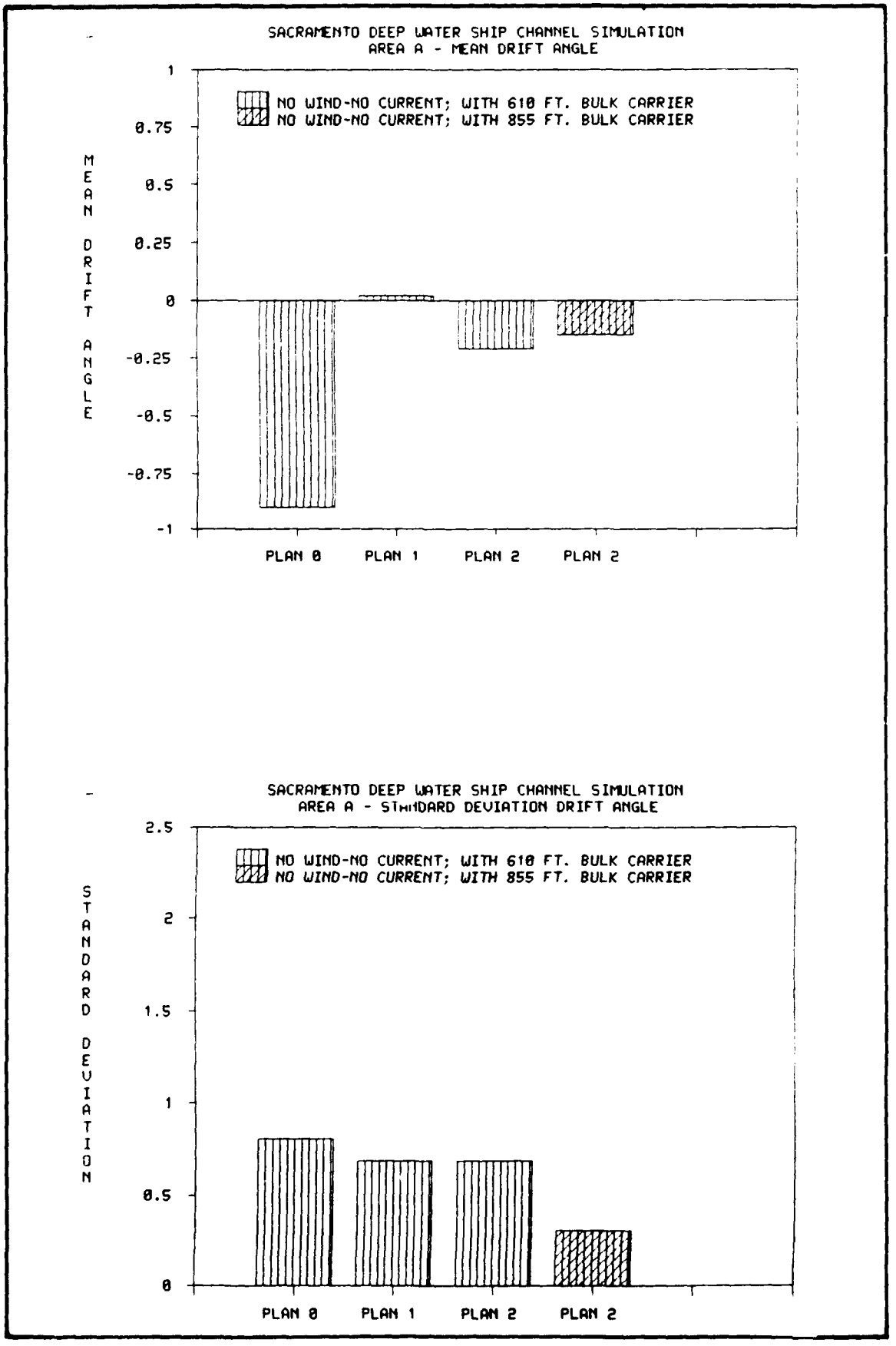
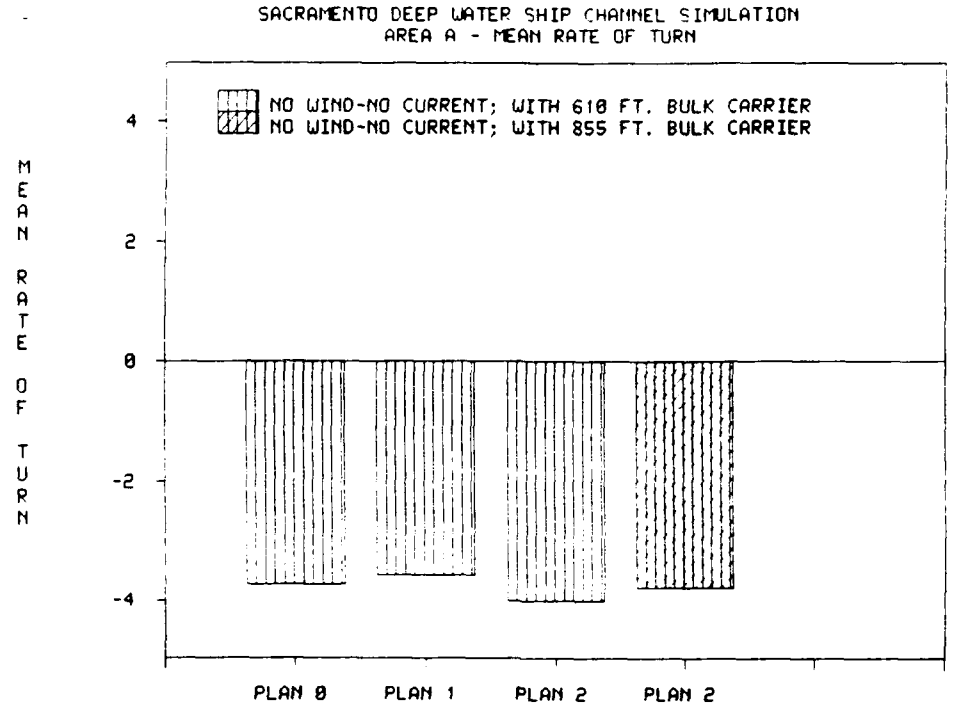

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN DRIFT ANGLE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN DRIFT ANGLE
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
-1
PLAN 0
PLAN 1
PLAN 2
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION DRIFT ANGLE
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
STANDARD DEVIATION
2.5
2
1.5
1
0.5
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C20


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN RATE OF TURN
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN RATE OF TURN
4
2
0
-2
-4
PLAN 0
PLAN 1
PLAN 2
PLAN 2

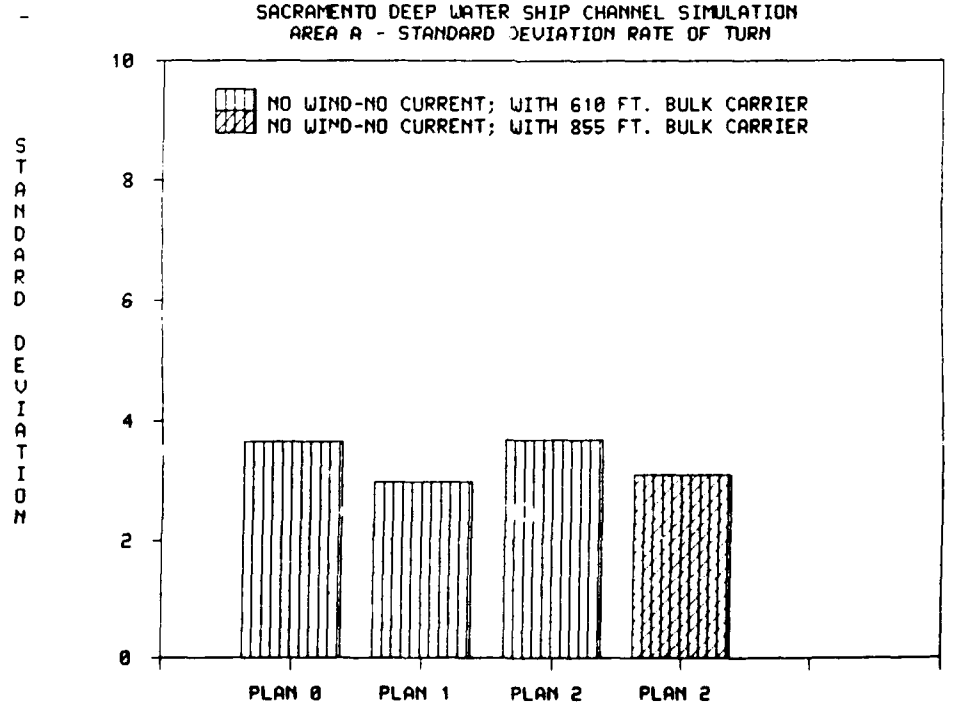

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION RATE OF TURN
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
STANDARD DEVIATION
10
8
6
4
2
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C21

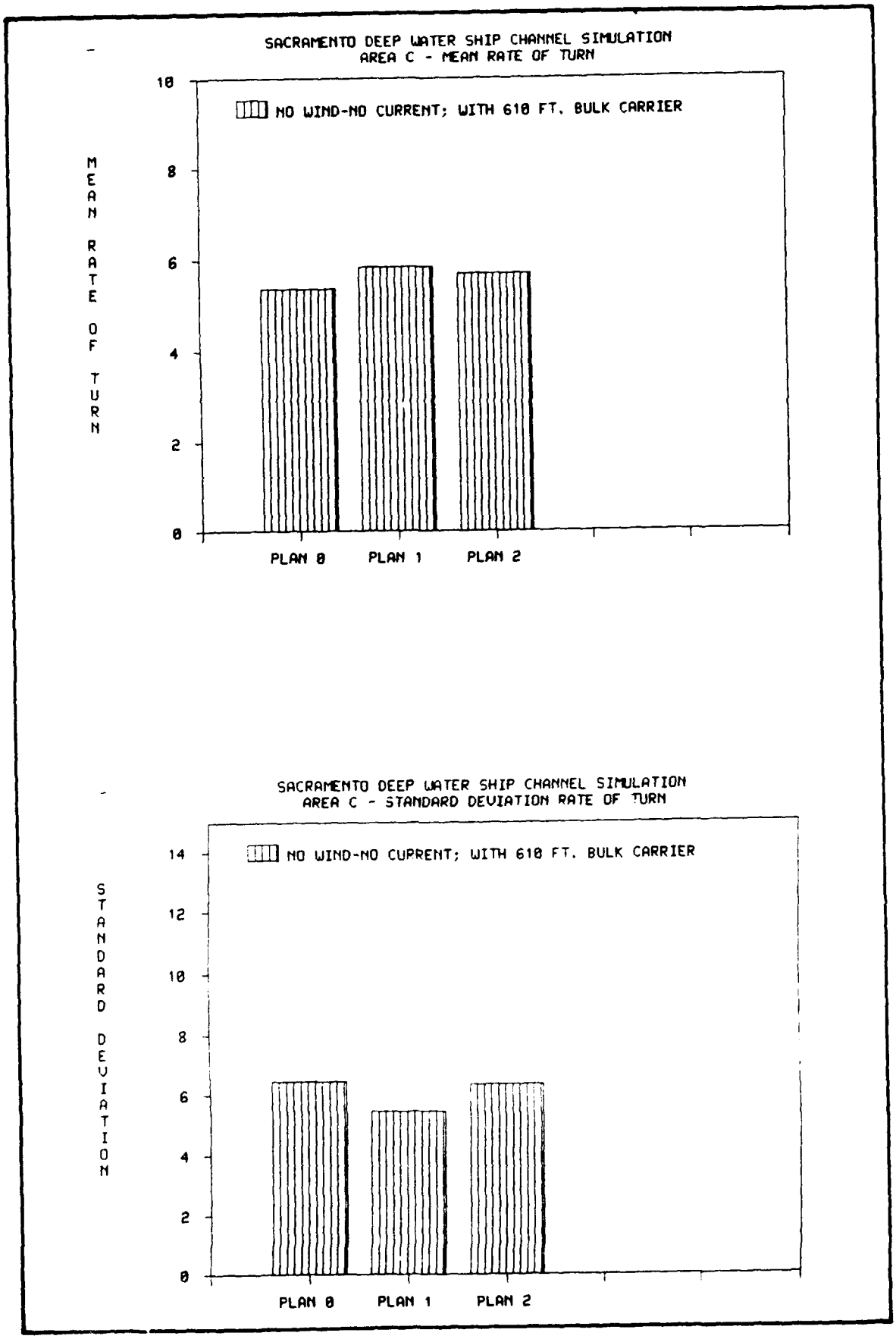
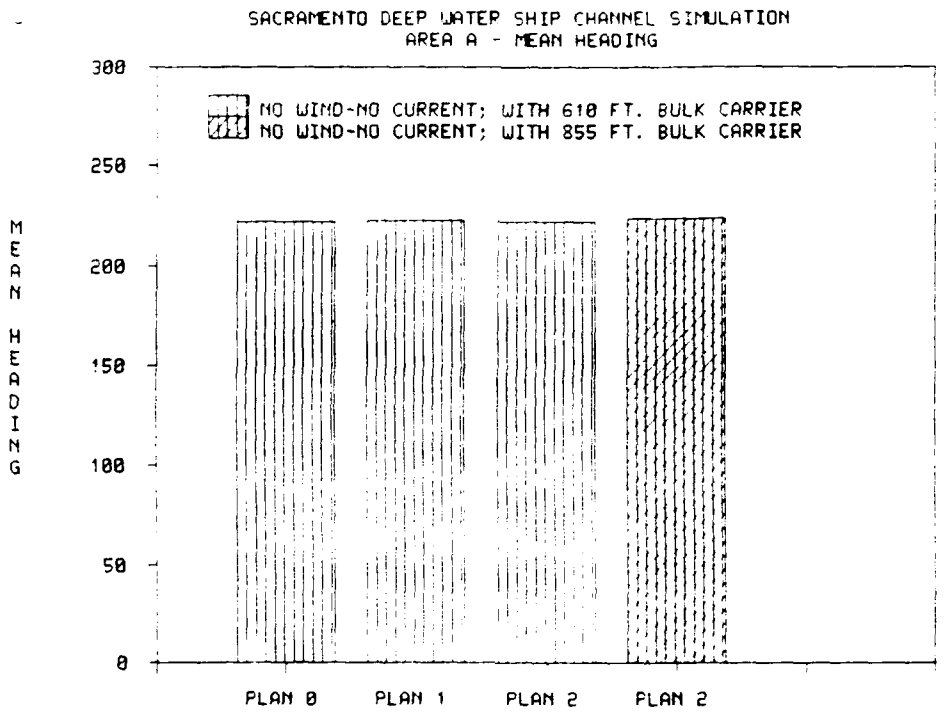

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN RATE OF TURN
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
MEAN RATE OF TURN
10
8
6
4
2
0
PLAN 0
PLAN 1
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION RATE OF TURN
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
14
12
10
8
6
4
2
0
PLAN 0
PLAN 1
PLAN 2

PLATE C22


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN HEADING
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN HEADING
300
250
200
150
100
50
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

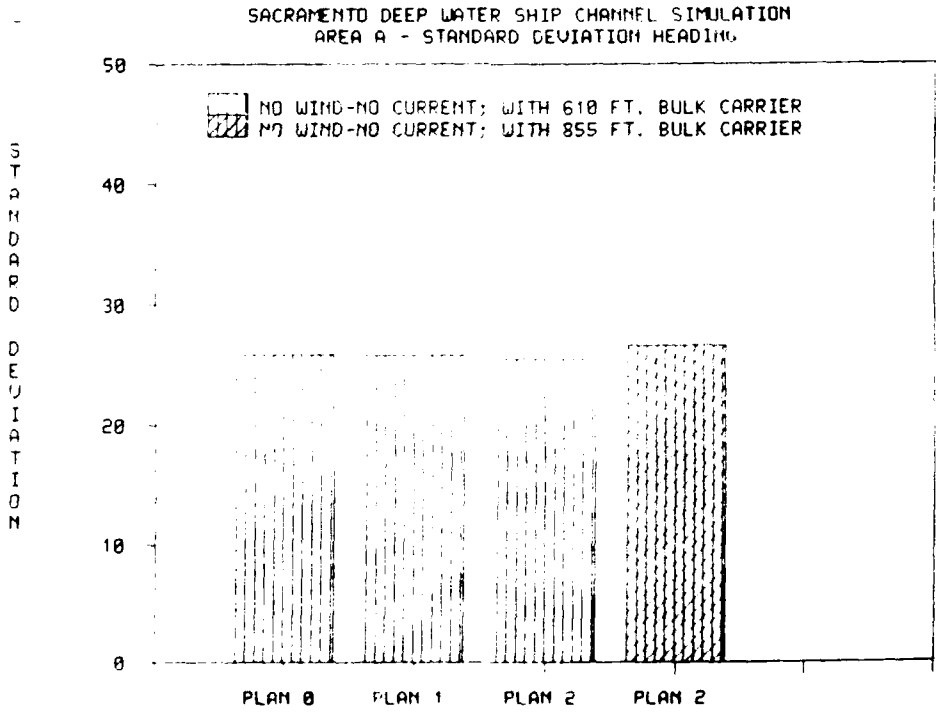

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION HEADING
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
STANDARD DEVIATION
50
40
30
20
10
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C23

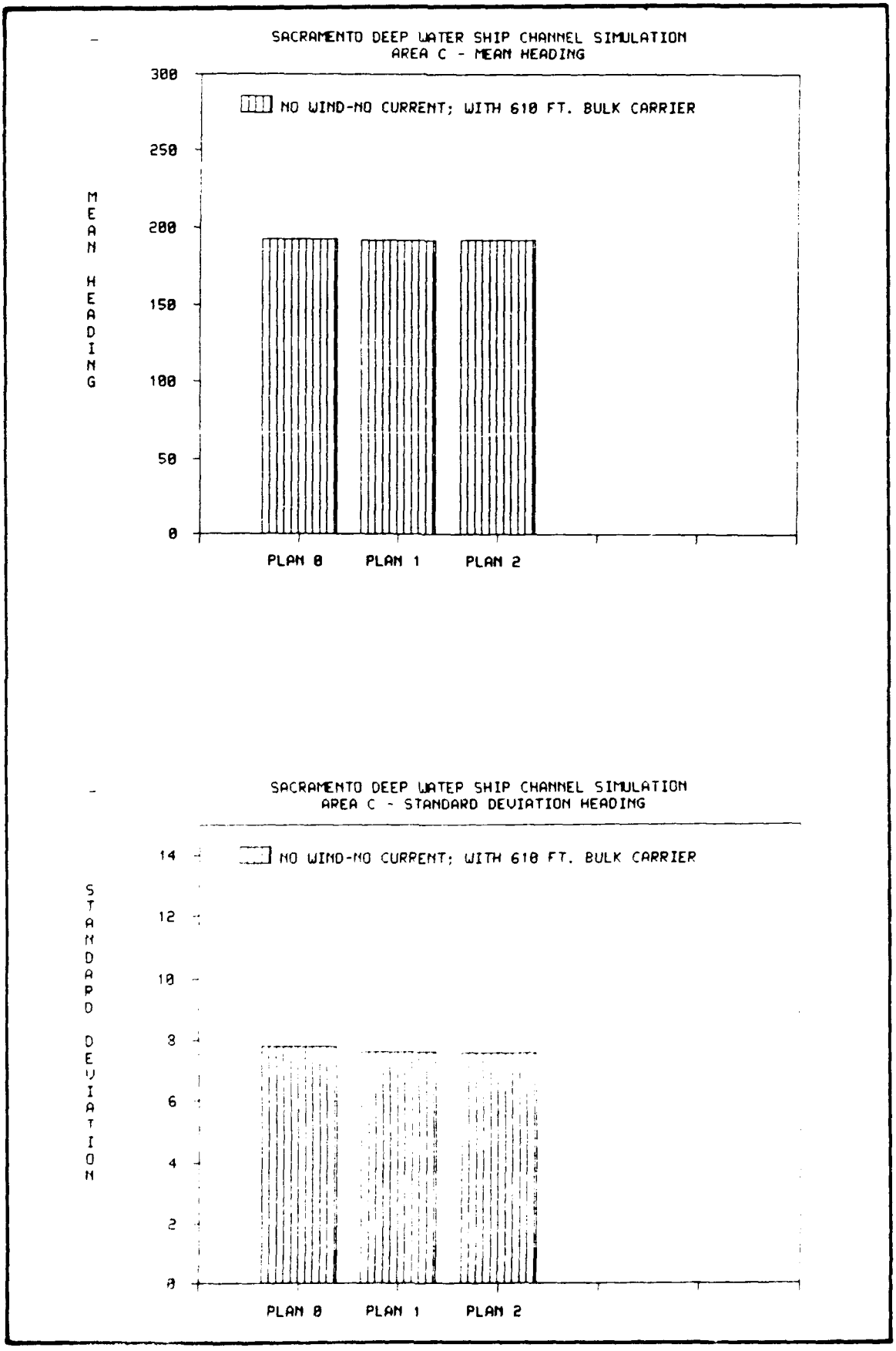

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN HEADING
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
MEAN HEADING
300
250
200
150
100
50
0
PLAN 0
PLAN 1
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION HEADING
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
14
12
10
8
6
4
2
0
PLAN 0
PLAN 1
PLAN 2

PLATE C24

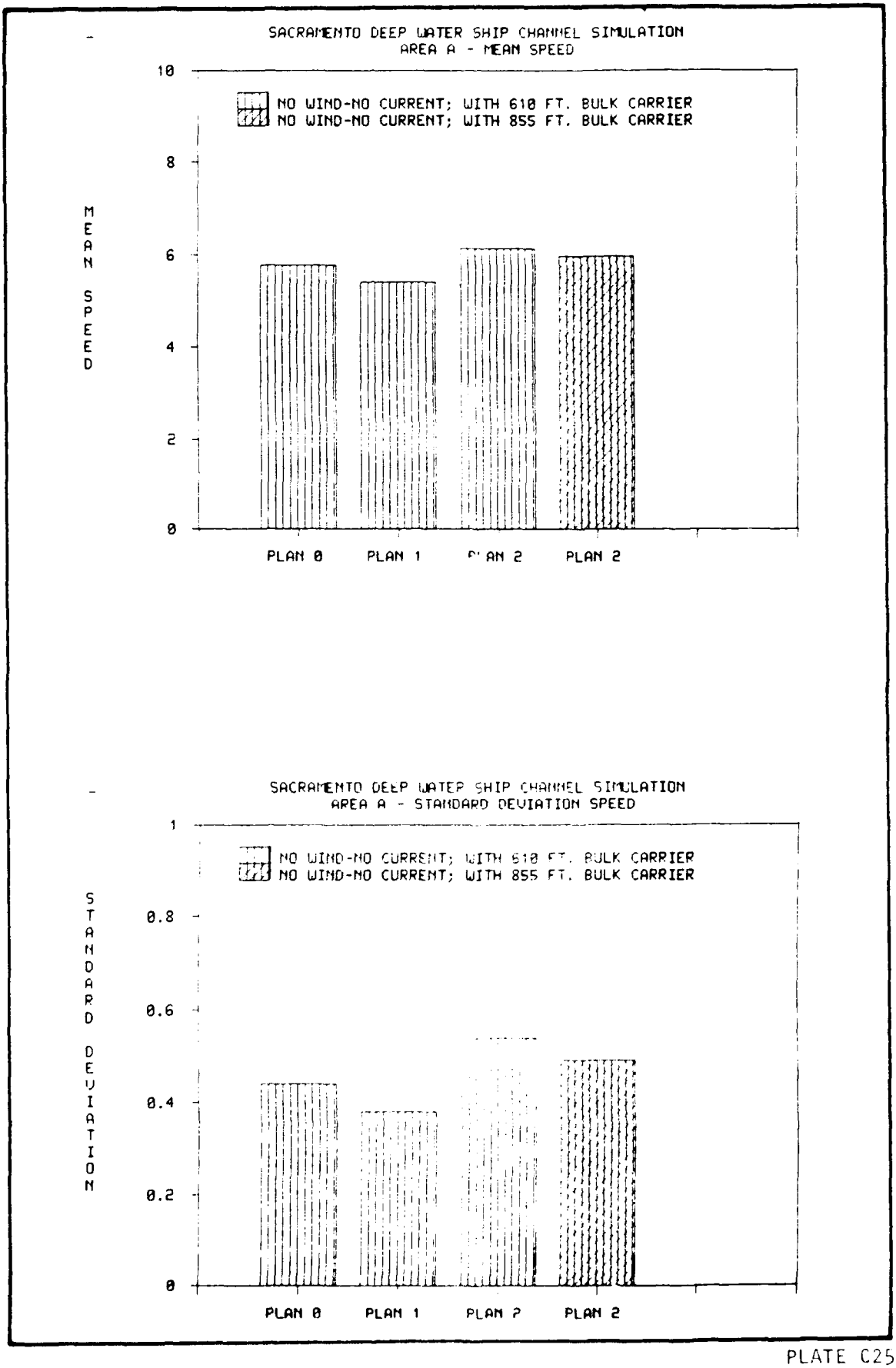

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN SPEED
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN SPEED
10
8
6
4
2
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION SPEED
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
STANDARD DEVIATION
1
0.8
0.6
0.4
0.2
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C25

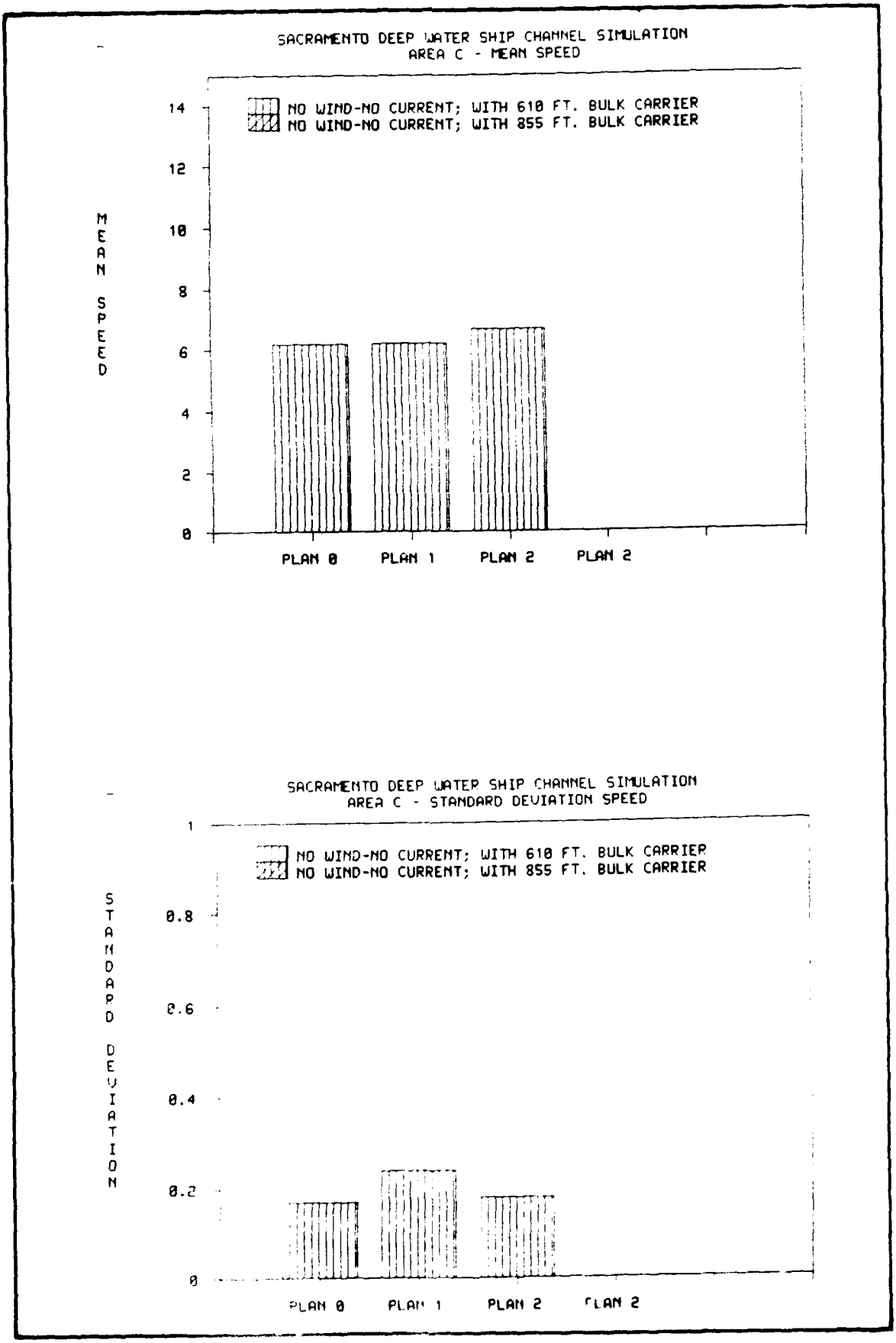
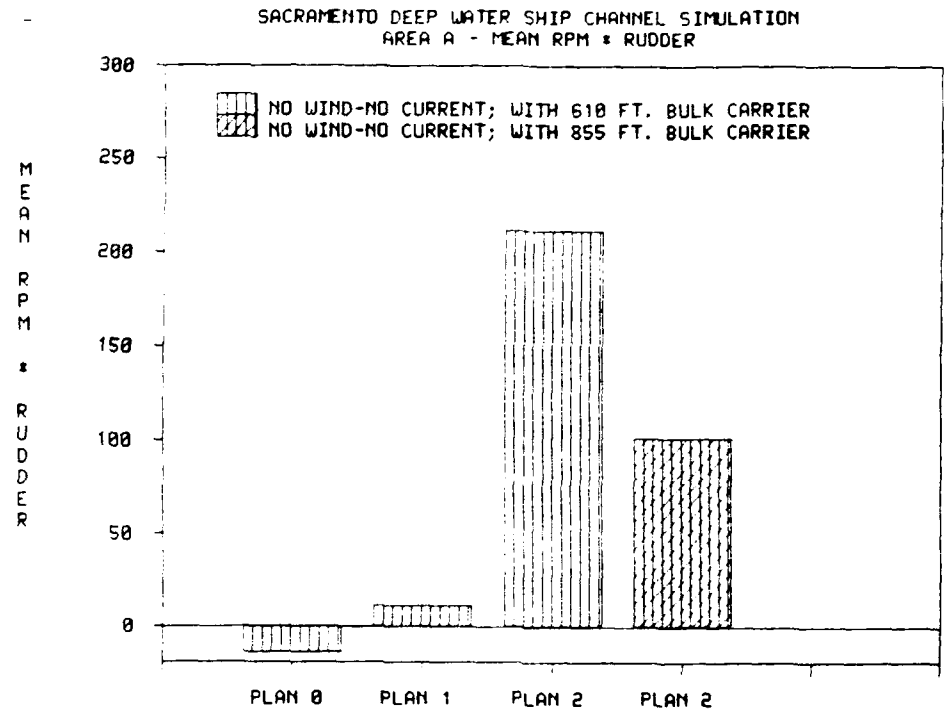

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN SPEED
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN SPEED
14
12
10
8
6
4
2
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION SPEED
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
STANDARD DEVIATION
1
0.8
0.6
0.4
0.2
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C26


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - MEAN RPM ± RUDDER
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
MEAN RPM ± RUDDER
300
250
200
150
100
50
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

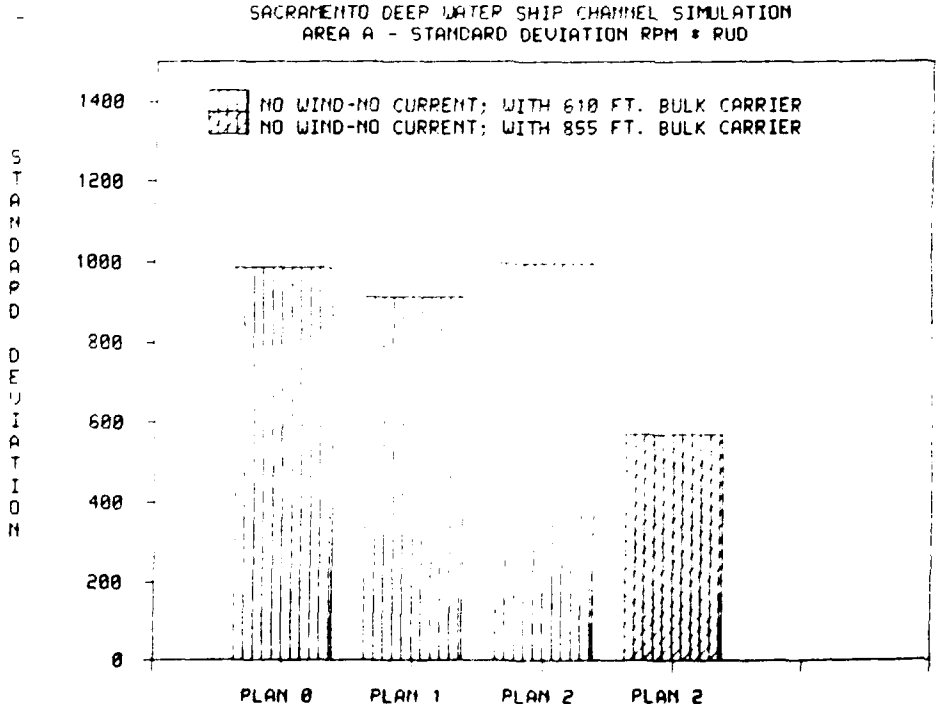

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION RPM ± RUD
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
NO WIND-NO CURRENT; WITH 855 FT. BULK CARRIER
STANDARD DEVIATION
1400
1200
1000
800
600
400
200
0
PLAN 0
PLAN 1
PLAN 2
PLAN 2

PLATE C27

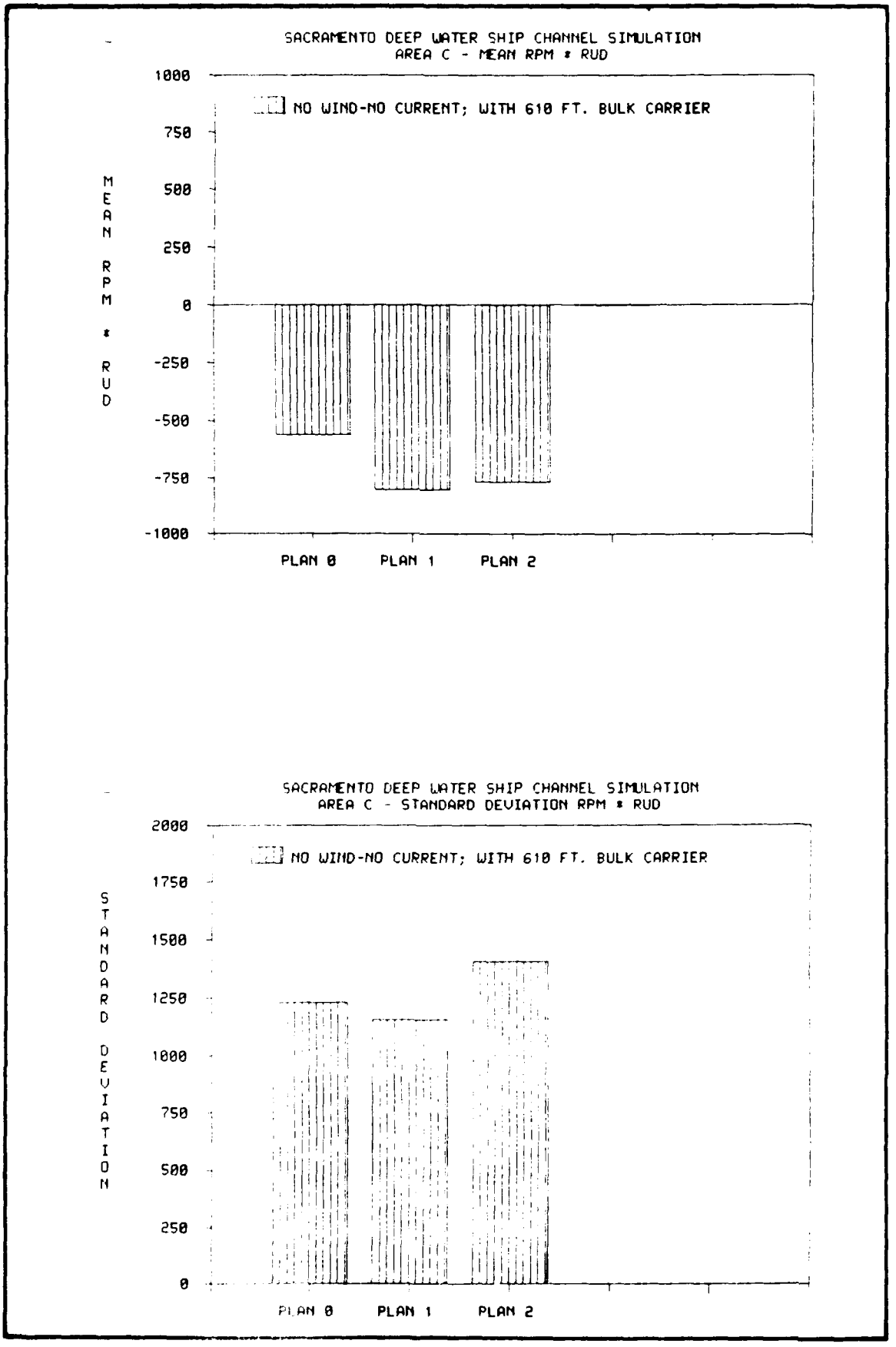

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN RPM ± RUD
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
MEAN RPM ± RUD
1000
750
500
250
0
-250
-500
-750
-1000
PLAN 0
PLAN 1
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION RPM ± RUD
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
2000
1750
1500
1250
1000
750
500
250
0
PLAN 0
PLAN 1
PLAN 2

PLATE C28

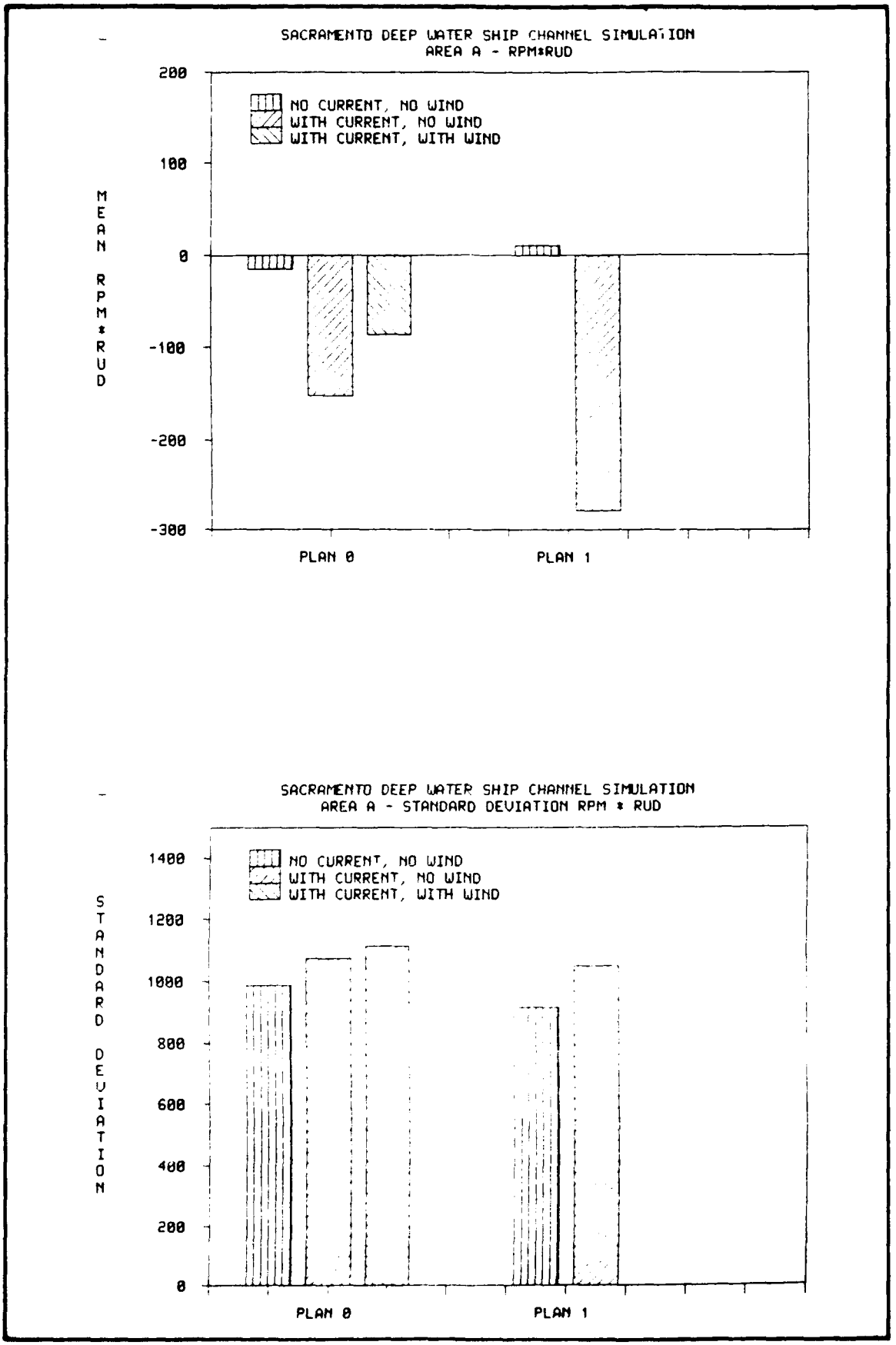

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - RPM*RUD
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
MEAN RPM*RUD
200
100
0
-100
-200
-300
PLAN 0
PLAN 1
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA A - STANDARD DEVIATION RPM * RUD
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
STANDARD DEVIATION
1400
1200
1000
800
600
400
200
0
PLAN 0
PLAN 1

PLATE C29

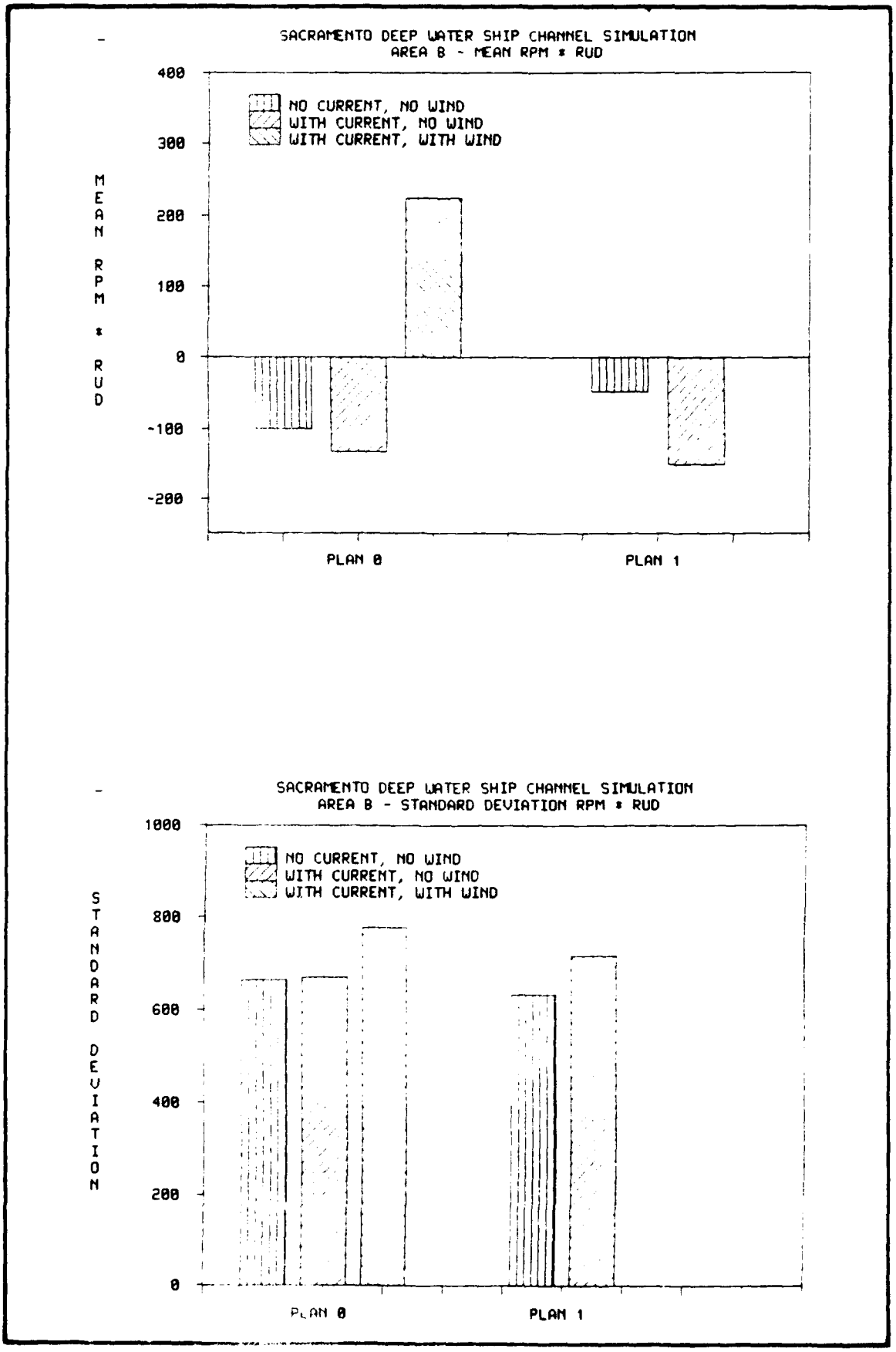

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - MEAN RPM * RUD
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
MEAN RPM * RUD
400
300
200
100
0
-100
-200
PLAN 0
PLAN 1
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - STANDARD DEVIATION RPM * RUD
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
STANDARD DEVIATION
1000
800
600
400
200
0
PLAN 0
PLAN 1

PLATE C30

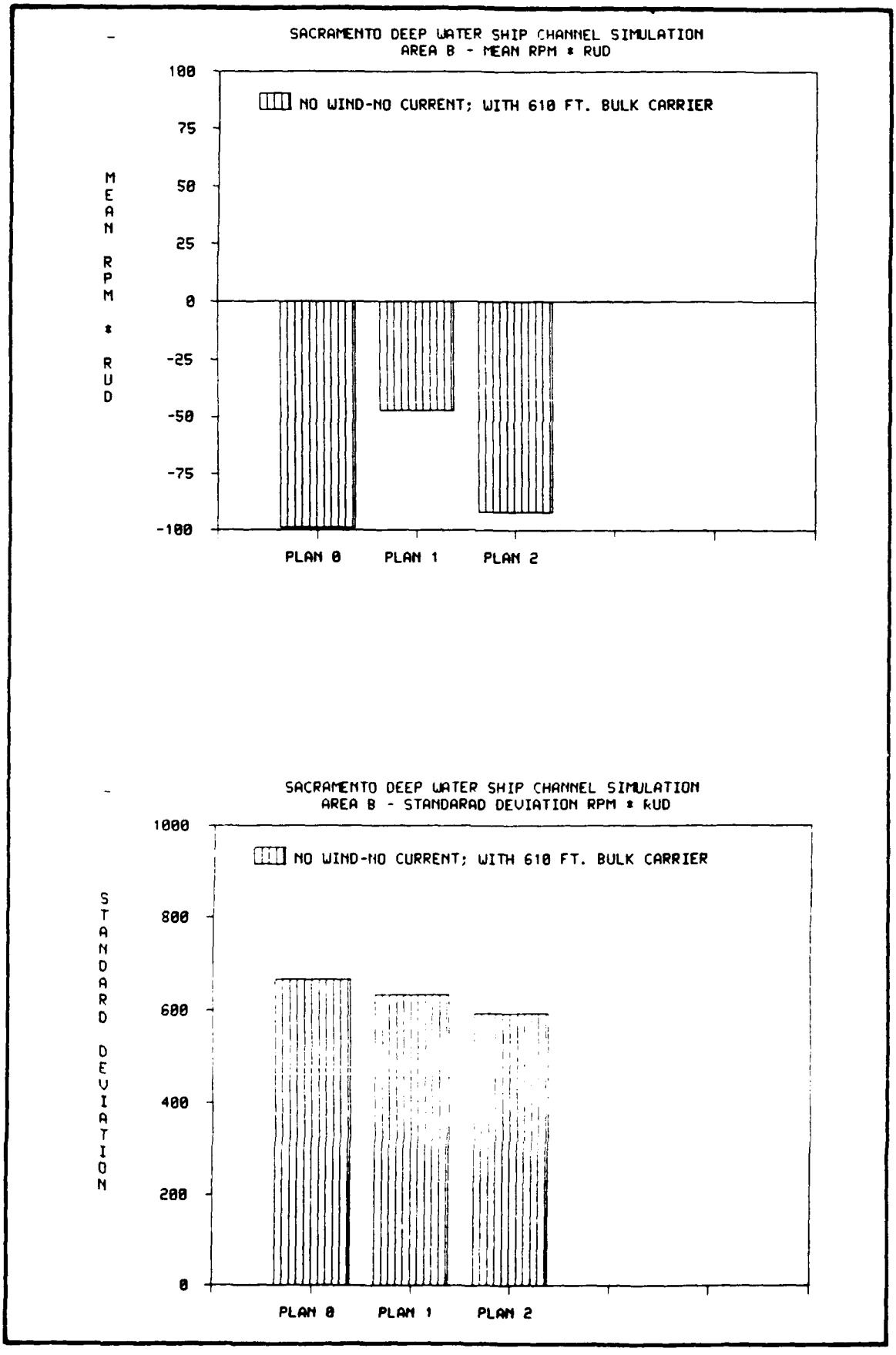
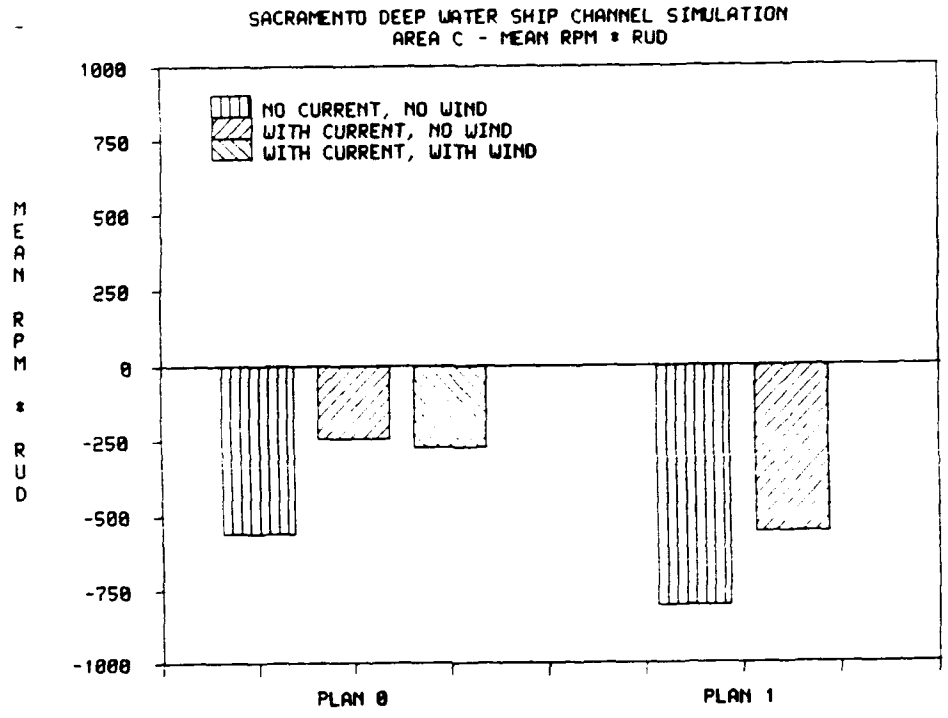

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - MEAN RPM * RUD
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
MEAN RPM * RUD
100
75
50
25
0
-25
-50
-75
-100
PLAN 0
PLAN 1
PLAN 2
SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA B - STANDARAD DEVIATION RPM * RUD
NO WIND-NO CURRENT; WITH 610 FT. BULK CARRIER
STANDARD DEVIATION
1000
800
600
400
200
0
PLAN 0
PLAN 1
PLAN 2

PLATE C31


SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - MEAN RPM * RUD
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
MEAN RPM * RUD
1000
750
500
250
0
-250
-500
-750
-1000
PLAN 0
PLAN 1

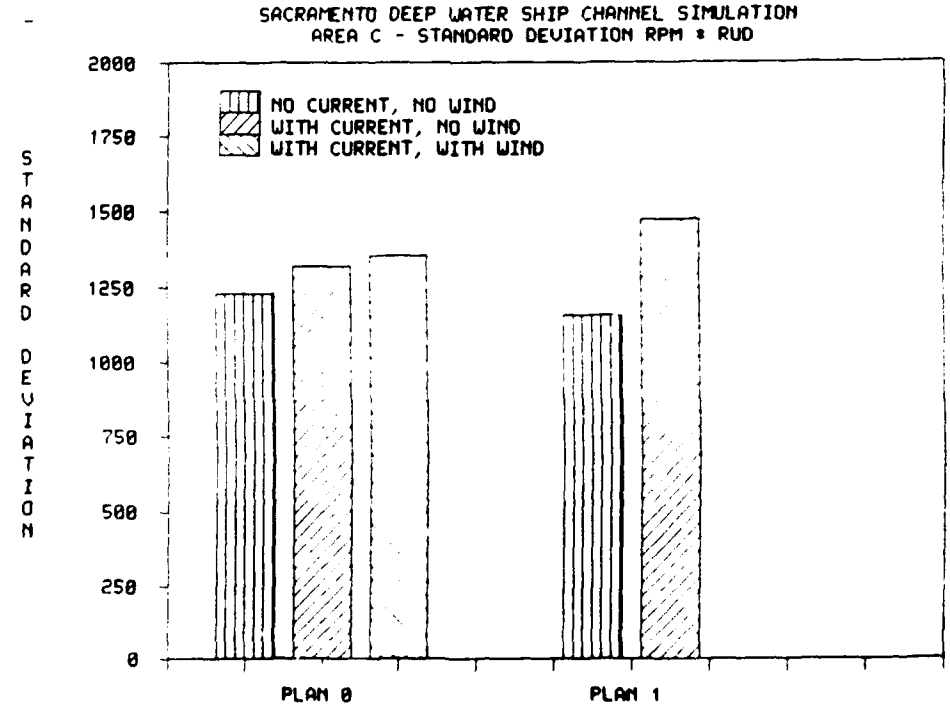

SACRAMENTO DEEP WATER SHIP CHANNEL SIMULATION
AREA C - STANDARD DEVIATION RPM * RUD
NO CURRENT, NO WIND
WITH CURRENT, NO WIND
WITH CURRENT, WITH WIND
STANDARD DEVIATION
2000
1750
1500
1250
1000
750
500
250
0
PLAN 0
PLAN 1

PLATE C32